SCIENTIFIC AMERICAN

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Vol. XCIII.—No. 6.
ESTABLISHED 1845.

NEW YORK, AUGUST 5, 1905.

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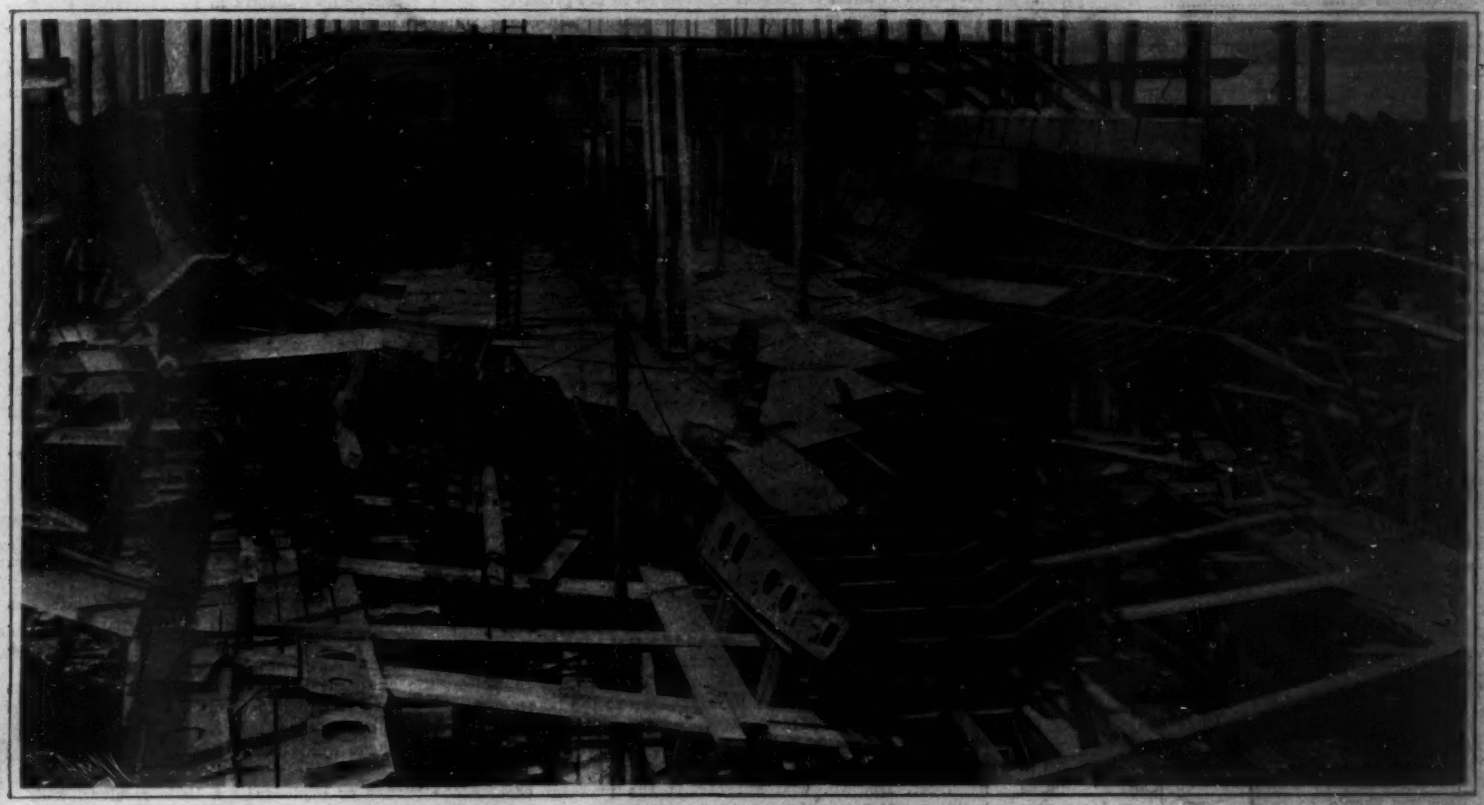
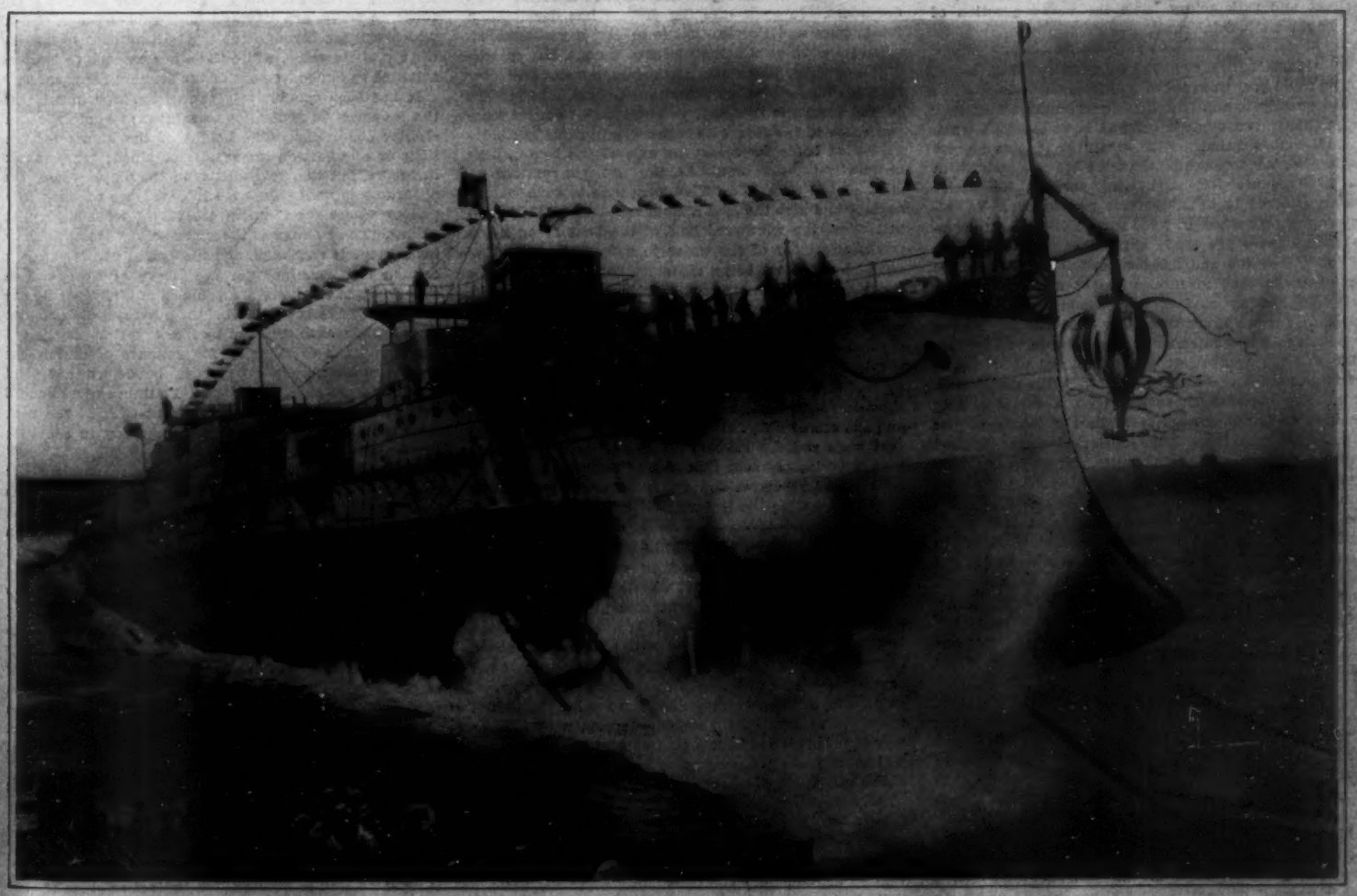


This View of the "Kashima" Shows the Deep Framing and Inside Plating of the Double Bottom; Also the Deck Beams That Carry the Protective Deck, and One of the Watertight Bulkheads.



Launch of the "Katori."

Length, 435 feet 9 inches. **Beam,** 78 feet. **Draft,** 27 feet. **Displacement,** 16,000 tons. **Armor:** Belt, 9 inches. Side, 6 inches. Barbettes, 9 inches and 6 inches. **Armament:** Four 12-inch; four 10-inch; twelve 6-inch; 21 small guns. **Torpedo Tubes,** 5 submerged.

THE NEW JAPANESE SISTER BATTLESHIPS "KASHIMA" AND "KATORI"—[See page 105.]

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MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, AUGUST 5, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE LESSON OF THE "BENNINGTON" DISASTER.

The awful tragedy on the gunboat "Bennington," due to the explosion of one of her boilers, has shocked the people of the United States more than any naval disaster since the blowing up of the "Maine" in Havana harbor. The loss of so many lives is rendered doubly painful by the conviction that the accident was entirely preventable. This conviction is based on the fact that the construction, inspection, and care of boilers are now so thoroughly understood, that, if proper precautions are exercised, a boiler explosion is practically impossible. In the exhaustive investigation that will be made by the Navy Department, evidence may be offered that will excuse both the engineering force on the ship and the system under which they worked; but the fact that the motive power of this war vessel was in the sole charge of a young officer, whose age rendered it impossible that he should have had the necessary experience to qualify him for such a great responsibility, suggests that the system may be partly responsible for the disaster.

It is a notorious fact that new ships are being added to our navy faster than adequately trained and experienced officers can be found to man them, and we understand that the scarcity is being felt more severely in the Department of Steam Engineering than in any other branch of the service. One of the first duties of Congress should be to make provisions for a considerable increase in the yearly supply of qualified engineers; and at the same time it should settle on a permanent and satisfactory basis the vexed question of the engineers' official rank.

MECHANICAL STOKERS ON LOCOMOTIVES.

The rapid growth in the size of locomotive boilers has added greatly to the labors of the fireman. Just how great this increase has been, will be understood when it is remembered that in 1893, when the famous express engine No. 999 was exhibited at the World's Fair, with its 1,900 square feet of heating surface, the boiler was considered to be of extreme proportions. Yet today a heating surface of 3,000 square feet is quite common, and there are many express engines that have as much as 3,400 and 3,500 square feet. Now, these figures mean that in the course of a decade and a half the heating surface of locomotives has about doubled; for we must remember that No. 999 was a great advance on contemporary practice, in which from 1,500 to 1,700 square feet was considered to be a generous allowance of heating surface. With the growth of heating capacity there has been a corresponding increase in grate surface, and in the labors of the fireman to keep these huge modern boilers supplied with coal. In a run of 150 miles, except in the very lightest trains, the fireman is never seated. When he is not handling the injector, or peering ahead to catch the first glimpse of a railroad signal, he is steadily loading coal into the firebox. The fireman's labors have increased enormously; for the great length of the firebox, which is necessary to provide the big grate surface, calls for increased physical exertion in throwing the coal forward so as to scatter it evenly over the more remote portions of the grate. The matter has reached a point where the question of employing two firemen has come up for consideration by railroad officials; it is being urged by the labor associations; while in more than one legislature an attempt is being made to regulate the matter by law. The railroad companies object to the presence of a third man, partly on the ground of the expense, and partly because it is thought that for reasons which we fail to grasp the efficiency of the lookout might be impaired thereby.

In this connection the question of the use of the mechanical stoker becomes of considerable importance. One or two types of such stokers have been tested with a fair amount of success, and there can be no doubt that the time has come when the matter should be taken up in the same thorough manner in which the recent locomotive tests were carried out by the Pennsylvania Railroad Company at the St. Louis Fair. The mechanical stoker is such a great success in stationary boiler plants, that it is reasonable to expect that, when its form has been modified to meet the special conditions of locomotive practice, it can be made to yield equally satisfactory results. One important advantage of its installation would be that the fireman could give considerably more attention to signals than is possible in his present overworked condition.

SEAWANHAKA CUP RETURNS TO AMERICA.

There has never been a period in the history of international sport in which this country has been concerned in so many important contests as in the present year. We have but to refer to the Transatlantic cup race, the contest for the Henley cup, the Gordon Bennett cup race, the rifle match between teams of the Seventh Regiment and the Westminster Volunteers, the challenge for the Davis tennis cup, and the challenge for the Seawanhaka cup for small yachts. Of these six international events, the first and last named have been won by the American representatives, and as both of these are yachting events, it will be seen how greatly this country is indebted to the noblest of all sports for its successes in what has been for us, in international contests, a decidedly "off" year.

Of the two yachting events, the winning of the Seawanhaka cup has really, in the eyes of yachtsmen, more significance than the winning of the Transatlantic race; for although the competing yachts for the Kaiser's cup were of the biggest size, they were a rather heterogeneous fleet, varying widely in size and age, some of them being racing yachts pure and simple, and others comfortable old cruisers that were never intended for racing of any kind. The contest just concluded for the Seawanhaka cup was, however, of a very different kind, the competing boats representing a highly-developed racing model, in which the yacht designer and the engineer combined their efforts to secure the single object of high speed. In this respect the Seawanhaka contests are, in the class of small boats, what the "America" cup contests are among the 90-footers.

The Seawanhaka challenge cup was won by a Canadian boat just nine years ago, and in every intervening year since it was captured, various American clubs have challenged, built a fleet of yachts out of which to select a representative, and have gone up to the lakes, and sailed a series of more or less hotly contested races, only to go down to defeat. The credit for the lengthy stay of the cup in Canada is due to a young civil engineer, Mr. Duggan, who approached the problem of building a 21-foot racing craft in exactly the same way in which that other engineer, Mr. Herreshoff, has worked out the same problem in the "America" cup defenders. In each case the process has developed a freak, pure and simple, that is to say, a yacht which, when its work of attack or defense is done, has practically no further usefulness to the yachtsman. Just how freakish the Seawanhaka boats have come to be may be judged from the fact that in one series of races Duggan came to the line with what was practically a double-hulled boat; for along the axis of the boat, where ordinarily the keel would be, the hull was rounded up clear of the waterline. This was done to save wetted surface and give the boat a long, fine, canoe-like hull to sail upon, the windward half of the boat being lifted practically clear of the water in a fresh breeze. The double-hulled boat being mutually barred from future races, the Canadians next brought out a broad, shoal craft, designed to sail upon its bilges and provided with two centerboards and two rudders, set normal to the curve of the bilge and, therefore, standing vertically in the water when the little craft was heeled by the wind. The "Manchester," representing the Manchester Yacht Club, was built on these general lines, and she scored a decisive win by taking the three races that were sailed. Take it all in all, there has never been a series of races that has been characterized by such friendly competition and good, clean sportsmanship as these for the Seawanhaka challenge cup.

WEAR OF CAR WHEELS ON CURVES.

An editorial which appeared in our issue of May 27, on the subject of the wear of wheels of cars when moving over curves, has brought several letters to the Editor's desk, asking whether it is not a fact that the tread of a car wheel is turned with a tapered or coned face, for the purpose of overcoming the slipping of one or other of a pair of wheels in running around a curve. In answer to these correspondents we point out that if the tread of a pair of wheels be formed with a taper corresponding to the sharpness of a given curve, they will move around the curve without any slipping; but if the same pair of wheels be run over other curves of smaller or larger radius, one or other of the wheels must slip. Hence it follows that, in actual practice, where the curves vary so greatly, the coning of the wheels can have only a very limited effect in the prevention of slipping. The theory of the coned wheels is that, in passing around a curve, the centrifugal force causes the train to hug the outside or longer rail, and as the diameter of each wheel at the flange is larger than at the edge opposite the flange, the outer wheel on the curve, or the wheel bearing on the outer and longer rail, is running on a larger diameter tread than is the inner wheel. It can readily be seen that if the taper of the tread has the proper ratio to the curvature of the rails, there will be no slip of either wheel on its rail. This is a condition, however, that occurs but rarely in practice.

PROTECTION AGAINST FIRE DAMP.

The problem of safeguarding the lives of the toilers in our mines is one that lends itself to a great deal of experiment, resulting in processes and instruments of more or less value to science and the world at large.

The recent mine disasters in Pennsylvania, the horrors of which are still fresh in our memories, have resulted in some novel and intensely interesting experiments being made for the purpose of guarding against the dread results of accumulations of fire damp, as methane, or marsh gas, is commonly called.

One of the most interesting of these from a scientific standpoint, and the most successful from a practical point of view, is one that has been installed in a large colliery in Pennsylvania after careful and exhaustive trials that have resulted in a most satisfactory manner. This instrument is called a methanometer, and its successful working is based on the principle of the decomposition of methane in the presence of an excess of ordinary air under the influence of a high temperature. The high temperature is secured through an induction spark or an incandescent platinum wire, and the condensation is shown by a change of height in a column of mercury. The instrument consists of two component parts—the analyzers, which are placed throughout the galleries of the colliery, and the receiver or indicator, which is placed in the office under the eye of the superintendent.

The analyzer transmits each hour to the receiver the exact proportion of fire damp, between one and nine per cent, that is mingled with the air in that part of the mine where each analyzer is placed. Thus, when a dangerous proportion of fire damp is recorded in any part of the mine, the superintendent can issue the necessary orders for the ventilation of that part, and the apparatus will enable him to follow the results of the ventilation as indicated in the receiver.

In the analyzer, the burner, mercury column, and pendulum are attached to one side of a heavy bronze plate, while on the other side is attached the clutching mechanism, the whole being inclosed in a tight-fitting case.

The burner or exploder is a little receiver, with a fine platinum wire across its longest axis, and communicating with the mercury column or manometer. Extending from the side of the exploder are two glass tubes, to which are attached India-rubber tubes, one of which extends through the tight-fitting case to receive the air of the mine, while the other extends to bellows actuated by the movement of the sounding apparatus.

It has been conclusively shown by experiment that the manometric indications are always similar under similar conditions. The height of the barometer has little or no effect on the results obtained; temperature has more, but this varies little in the places where the apparatus is used. Suppose the analyzer to work in a gallery where the temperature varies from 30 deg. to 40 deg. The average is therefore 35 deg., to which the instrument is regulated, and the height of the mercury column is determined for a mixture of five volumes of marsh gas to ninety-five volumes of air. This height divided by five gives the height corresponding to one per cent of marsh gas, and by like experiments the different heights of mercury for volumes of marsh gas from one to nine per cent can be determined, and marked on the sides of the tube. Platinum wires should now be fused into the glass tube at each of the nine marks, and the manometer will be ready to act with its exploding chamber.

The nine platinum wires from the manometer are connected with an equal number of platinum plates insulated in ebonite and arranged in the form of an arc. Just below the center of the arc is attached a ratchet wheel furnished with pawls, and carrying a contact rod which passes from plate to plate as the wheel turns. The mercury of the manometer is in permanent contact with one of the poles of the battery, while the ratchet wheel and arc, through an electro-magnet actuating the pawls, is connected intermittently with the other pole of the battery. When the mercury in the manometer rises as high as the first platinum wire, the current is closed, and passes through the platinum connecting wire to the first plate of the arc, thence through the contact rod into the ratchet wheel and its pawls.

The electro-magnet actuating the ratchet wheel is now magnetized, and turns the wheel until the contact rod rests on the second plate of the arc, thus opening the circuit. When the mercury in the manometer reaches the second platinum wire, the above operation is repeated, and so on, until the contact rod reaches the last plate, where a contact arrangement holds the lever actuated by the electro-magnet until the ratchet wheel and contact rod resume their normal position through the influence of a weight.

The receiver, or indicator, which is placed in the office, is somewhat similar in appearance and action, but more simple in construction, inasmuch as the nine plates above described are replaced by a numbered dial indicating from one to nine the percentage of fire damp as analyzed by the instrument in the mine. Just below each number on the dial is a hole in which plugs may be inserted that will make an electrical contact with the pointer. By placing a plug in the hole corresponding to a proportion of fire damp beyond which the mine is not thought safe, continuous ringing of a bell will result. The movement of the pointer is resultant from a contact effected when the contact rod of the instrument in the mine passes from one plate to another.

The mechanisms of the separate instruments of the methanometer are actuated by clockwork, operating the bellows supplying the analyzer with mine air, throwing the platinum wire of the analyzer into incandescence, and performing the other mechanical operations necessary to the operation of the different instruments.

At the time set for an analysis, a circuit is closed that drops a lever across the two tubes leading into the burner, crushing them flat, and thus shutting off the supply of air; a second later a circuit is closed, which brings the platinum wire into incandescence, lasting for fifteen seconds.

After a lapse of one minute, the platinum wire is again thrown into incandescence for another fifteen seconds. Five minutes later, during which five minutes the transmitter is recording the result of the analysis in the receiver, the lever closing the India-rubber tubes is lifted, thus permitting a fresh supply of air to reach the burner. The mercury therefore resumes its normal position, as also does the contact rod and pointer.

The reason for raising the platinum wire twice to incandescence for fifteen seconds, with an interval of one minute, is as follows: The wire being suddenly raised to a very high temperature dilates instantaneously the gas in the burner; one part of this gas escapes combustion, being drawn once more into the manometer during the minute allowed for cooling. During the second incandescence this gas returns to the burner, where its consumption is procured almost entirely.

Owing to the fact that the mechanism is actuated by clockwork, it is possible to connect at least six analyzers with one receiver, by arranging the analyzers to operate at intervals of ten minutes each. By reference to the time, it can easily be ascertained from which analyzer the report is coming.

YELLOW FEVER PREVENTED BY MOSQUITO EXTERMINATION.

Within the past few weeks there has been a gradual increase in the number of new cases and deaths by yellow fever in New Orleans, La., which is of so alarming a character as to cause representatives in adjoining States and in Havana, Cuba, to set up a quarantine against the city.

It is reported about twenty-five plague-infested centers have been located, the first and largest being near the French market, covering an area of forty city blocks. Frightened Italians, who would not consult physicians, scattered among friends in the outer portions of the city, and were there taken down with disease. It was noticed at these outside centers that the spread of the disease was curtailed because the patients were subjected to scientific treatment and kept perfectly screened, while the premises were cleared of mosquitoes. The city authorities favor the thorough cleaning of the streets of dirt and filth as the best means of checking the spread of the fever, but President Kohnke, of the city Board of Health (author of the well-known paper on "Mosquito Fever Propagation" in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1518 and 1519, read before the American Society of Mosquito Extermination last winter) states: "Cleaning up streets and removing dirt from gutters is energy thrown away. You ought to put every man you can get hold of to screening cisterns and draining standing water from premises and ridding the city of mosquitoes."

This is a very quick and practical method of control which, if properly carried out, should aid materially in quelling the epidemic.

In New Orleans the situation as to water supply is different from most cities. In place of an underground pipe system, a double set of cisterns are erected alongside of or back of each residence for the collection of rain water. It is estimated there are 75,000 of these cisterns in New Orleans, which form so many pools of water suitable for mosquito breeding. It is to prevent the escape of the mosquitoes by covering the cisterns with screens that Dr. Kohnke so urgently recommends as one means of checking the spread of the fever.

The success in eradicating yellow fever from Havana, Cuba, is due to scientific methods, especially in preventing the propagation of mosquitoes, and in protecting suspected cases against contact with mosquitoes by suitable screens.

Large engineering plans for draining vast swampy areas are now being carried out in many States, notably New Jersey, for the very purpose of eliminating the sources of mosquito propagation, producing more healthful and comfortable conditions in the surrounding country.

Mosquito prevention is a subject of pressing importance in every locality, and should be treated liberally by all public-spirited citizens and authorities.

HOW THE ANCIENT BABYLONIANS DRAINED THEIR CITY.

BY EDGAR JAMES BANKS, FIELD DIRECTOR OF THE BABYLONIAN EXPEDITION OF THE UNIVERSITY OF CHICAGO.

It is generally supposed that it is only modern man who has perfected a system of drainage and sewerage to carry from his house and city the overflowing rain water and the filth and garbage which accumulate. In the excavation of Bismya, the ancient Sumerian or pre-Babylonian city which flourished 4,500 years ago, a remarkable system of drainage, perfectly adapted to the alluvial plain of the Mesopotamian desert, has been discovered.

Babylonia is perfectly level; from Bagdad to the Persian Gulf there is not the slightest elevation, save for the artificial mounds or an occasional changing sand drift. In most places there is a crust of hard clay upon the surface, baked by the hot sun of summer time, so hard that it resembles stone. Parts of the desert are perfect for bicycle riding. Beneath the crust, which at Bismya is seldom more than four feet in thickness, and in places entirely lacking, is loose, caving sand reaching to an unknown depth.

Drainage in such a country, without sloping hills or streams of running water, might tax the ingenuity of the modern builder. In constructing a house, the ancient Sumerian of more than 6,000 years ago first dug a hole into the sand to a considerable depth; at Bismya several instances were found where the shaft had reached the depth of fourteen meters beneath the foundation of the house. From the bottom he built up a vertical drain of large, cylindrical, terra-cotta sections, each of which is provided with grooved flanges to receive the one above. The sections of one drain were forty-eight centimeters in diameter and sixty in height; others were larger and much shorter; the thickness of the wall was 2.7 centimeters. The tiles were punctured at intervals with small holes about two centimeters in diameter. The section at the top of the drain was semi-spherical, fitting over it like a cap, and provided with an opening to receive the water from above. Sand and potsherds were then filled in about the drain, and it was ready for use. The water, pouring into it, was rapidly absorbed by the sand at the bottom, and if there it became clogged, the water escaped through the holes in the sides of the tiles.

The temple at Bismya was provided with several such drains. One palace was discovered with four; a large bath, resembling a modern Turkish bath, and provided with a bitumen floor, sloping to one corner, emptied its waste water into one. The toilets in the private houses of 6,000 years ago were almost identical with those of the modern Arab house—a small oblong hole in the floor without any seat. Several found at Bismya were provided with vertical drains beneath.

In clearing out the drains, a few of them, whose openings had been exposed, were filled with the drifting sand; others were half full of the filth of long-past ages; in one at the temple, we removed dozens of shallow, terra-cotta drinking cups, not unlike a large saucer in shape and size. Evidently, it received the waste water of a drinking fountain, and the cups had accidentally dropped within.

In the Bismya temple platform, constructed about 2750 B. C., we uncovered a horizontal drain of tiles, each of which was about a meter long and fifteen centimeters in diameter, and not unlike in shape those at present employed. It conducted the rain water from the platform to one of the vertical drains. One tile was so well constructed that for a long time it served as a chimney for our house, until my Turkish overseer suggested that its dark, smoked end project from the battlements of the house, to convince the Arabs that we were well fortified; thus it served as a gun until the close of the excavations.

In other parts of the temple more elementary drains were employed to carry off the surface water from the slightly inclined platform. It consisted simply of a groove constructed of bricks, or arranged by omitting the bricks in the floor; frequently the groove was continued down over the vertical edge of the platform.

The Babylonians of a later period, who buried, instead of cremating their dead, carefully provided their cemeteries with drains. The graves were small house-shaped structures entirely or partly above ground, and whenever they were found upon the sloping side of a mound, they were protected above by a breakwater, while along the sides were square, open brick drains. The result was that some of the graves, although thousands of years old, and constructed of unbaked clay, are still in a perfect state of preservation.

To the student of architecture it may be surprising to learn that the arch, until recently supposed to have been unknown to the ancients, was frequently employed by the pre-Babylonians of more than 6,000 years ago. Such an arch in a poor state of preservation was, a few years ago, discovered in the lowest stratum, beneath the Babylonian city of Nippur. More recently an arched drain was found beneath the old city of Fara, which the Germans have excavated in central Babylonia. The city, although one of the earliest known, was built upon an earlier ruin, and provided with an arched drain constructed of small, plano-convex bricks. It measures about one meter in height, and has an equal width.

While delving among the ruins of the oldest cities of the world, we are thus finding that at the time when we supposed that man was primitive and savage, he provided his home and city with "improvements" which we are inclined to call modern, but which we are only reinventing.

SCIENCE NOTES.

Perhaps it is not wise to prophesy a time when enzymic diseases shall lose all their terror by reason of the discovery of effective antidotes to the poisons to which their ravages are generally due. It is reasonable, however, to look forward to the time when the terror of these diseases, namely, diphtheria, typhoid fever, typhus and kindred scourges shall be reduced to a minimum.

The decade from 1880 to 1890 may be called the golden age of ætiology, for in these years were discovered the hitherto unknown parasitic microbes of typhoid fever, tuberculosis, malaria, Asiatic cholera, diphtheria, and tetanus. The last decade of a century which has well been called "the wonderful," witnessed the discovery of antitoxins by Behring and the beginnings of serum therapy. With the single exception of the changes effected by the acceptance of the theory of organic evolution, there has been no modification of human opinion within the nineteenth century more wonderful, or more profoundly affecting the general conduct of human life, than that in our attitude toward the nature, the causation, and the prevention of disease—that is to say, toward public health science.

The determination of the presence of small quantities of foreign fat in lard is exceedingly difficult, and taxes the skill of the chemist to the utmost. Most fats which are suitable or available for mixing are so similar to lard in their physical and chemical properties that the determinations which suffice to detect their presence when they occur in large amounts or to identify them in their pure state are of little or no value in detecting the small amounts usually employed in adulterated lard. As a result, the chemist must depend to a large extent on certain qualitative or approximatively quantitative tests. Many of these tests are not based on any inherent property of the fat, but depend on some impurity, due perhaps to the method of manufacture, or, with animal fats, to the kind of food upon which the animal has been fed.

The absorptive systems of plants seem to be admirably adapted for their needs from a diosmotic point of view. Diffusion may, therefore, be sufficiently rapid to supply all demands of the absorbing cells or organs. Nevertheless, the assumption that ordinarily diffusion through the cell and plasmatic membrane is sufficiently rapid properly to provide for the translocation of metabolic products from cell to cell is certainly open to further inquiry. Present knowledge of the translocatory processes is insufficient. Plasmatic connections between cells are now known to be of common occurrence, and this fact has given further interest to the above inquiry. Brown and Escombe are of the opinion that the plasmatic connections are eminently adapted for all of those phenomena which they have found to belong, as subsequently mentioned, to multiperforate septa. They claim, further, that with slight differences of osmotic pressure the necessary concentration of gradient for increased translocation would be very simply effected.

The yield of oil and pomace that may be obtained from a given quantity or weight of castor beans varies according to the quality and condition of the beans and the climatic conditions under which they were produced. Beans of good quality contain about 45 per cent of oil, but 32 per cent is, on a general average, about the proportion of oil extracted by the process of manufacture used in the United States. The rather high proportion of about 13 per cent remains unexpressed in the pomace. The weight of imported castor beans as fixed by the United States tariff regulations is 50 pounds to the bushel, and consequently in the eastern mills it is customary to estimate the yield of oil and pomace, respectively, at 16 pounds (2 gallons) and 24 pounds to the bushel. In the West the weight per bushel of domestic castor beans is fixed at 46 pounds, and on this basis the yield of oil per bushel of beans would be 14.72 pounds (1.84 gallons) and of pomace 31.28 pounds.

Commander Peary sailed at two o'clock, July 26, from North Sydney, Nova Scotia, in his Arctic steamer "Roosevelt" on his quest for the Pole.

THE IMPROVEMENT OF THE OHIO CANALS.

BY W. FRANK MCCLURE.

One of the most important improvements ever undertaken by the State of Ohio is the creation of a new deep-water link between Lake Erie and the Ohio River—a work which will soon be actually under way. Eventually there will be important inland navigation, undoubtedly, from the great lakes to New Orleans by way of Cleveland and Marietta. This year's appropriations for this work by the State will go toward providing a seven-foot channel from Cleveland to Dresden, at which point the Muskingum will be tapped. The river and harbor bill, now before Congress, includes an appropriation of $8,000 for the dredging of the Muskingum and $110,000 for the building of a dam between Dresden and Zanesville, in order to give a continuous waterway from Cleveland to the Ohio River at Marietta. The people along the southern end of the Ohio canal are also agitating the improvement of the southern portion of the canal, and will bring the matter before the next legislature.

The Ohio canals, which in recent years have so deteriorated, were once an important factor in the industrial development of the State. The beginning of the original construction of this canal system dates back some eighty years, and at its inception it was considered an engineering and commercial triumph. For a little more than twenty years these canals continued to grow in usefulness. In 1861, they were leased to private parties for a term of ten years, and at the expiration of this time they were leased again for an equal period. When again turned over to the State they were badly in need of extensive repairs, and ever since they have been on the decline. It is now generally conceded by the people of Ohio that the canal system should be maintained and made more effective, and that it should remain the property of the people.

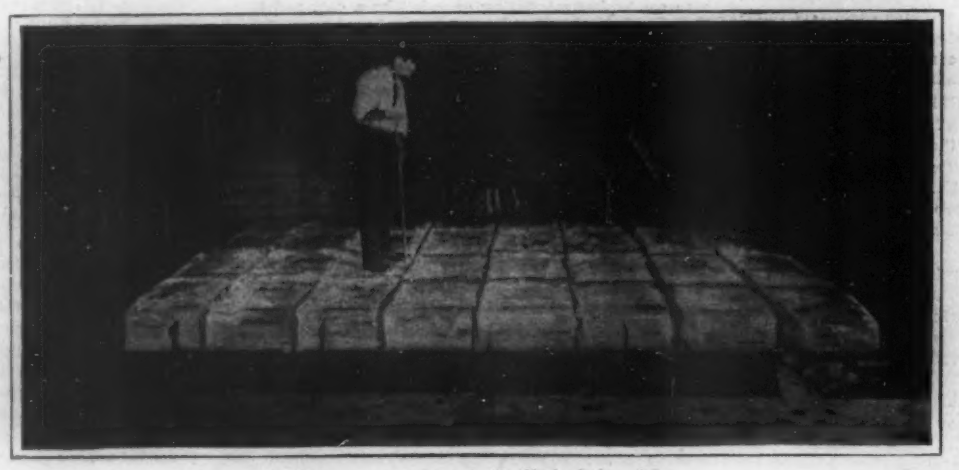
The State canal system comprises the Ohio and Erie and the Miami and Erie canals. What is known as the Ohio and Erie canal extends from the lake port of Cleveland to the Ohio River at Portsmouth, a distance of 309 miles, and in addition there are several navigable feeders. There are two summits, one being in Summit County, 35 miles from the lake level in the Cuyahoga River, and the other—Licking summit—being in Licking County, 116 miles from the Ohio River at Portsmouth. There are 42 locks between the lake and the first summit. Between this and the Licking summit—a distance of 133 miles—there are 48 locks. Between Licking summit and Portsmouth there are 53 locks. The summit in Summit County is nine miles long, 395 feet above Lake Erie, 78 feet above Licking summit, 491 feet above the Ohio River at Portsmouth, and 968 feet above the Atlantic Ocean. Over the new canal route to Marietta the distance from Dresden, where the new route will leave the old canal, to Marietta is about 90 miles. Licking summit is about 30 miles southwest of Dresden. The accompanying photograph illustrates the weigh lock of the Ohio apd Erie canal. It is situated near Cleveland, at what is without doubt the busiest place on the entire system. The boat shown in the illustration—the "Atlantic"—was built in 1863 and is still in service. There are numerous boats of similar size on the canal, weighing from 35 to 50 tons, and each one carrying from 75 to 80 tons of cargo. The length of one of these boats is 120 feet. This is the longest boat that can be weighed in the weigh lock. The latter is a small, separate canal, walled off from the canal proper by a partition of masonry. At each end of the lock there is a water gate, which lies flat on the bottom of the canal when open, and which is raised by means of chains and a gearing and crank on the stone wall at one side of the lock. When the boat to be weighed has been floated into the weigh lock and the gates have been closed, the water is released by the opening of a valve, and soon the boat is resting on the iron beams, which form the weighing platform of the scales. The weight of each boat is already known, and this is deducted from the weight of both boat and cargo, and the tolls are charged on the weight of the cargo. The weighing operation completed, the first valve is closed and another is opened, and soon the water has risen to the level of the canal, and the boat is ready to be towed out of the lock and on its way again. Along the northern portion of the Ohio canal, within less than 50 miles of Cleveland, are located manufactories employing a capital of $30,000,000, all of which depend upon the canal to furnish water for their boilers. Coal is brought to these factories in canal-boats direct from the mines.

WEIGHING A CANAL-BOAT IN THE CLEVELAND LOCK.

ICE-MAKING BY ELECTRICITY

BY HERIN E. DUNLAP.

What is believed to be the only electrically-operated ice-making plant in the United States has been installed by the Cataract Ice Company, of Niagara Falls, in a new brick building, 125 feet long, 44 feet wide, and which has a height of 28 feet. The greater part of the artificial or manufactured ice of to-day is made by one of two systems. These systems are known as the "can" system and the "plate" system. The Cataract Ice Company formerly used the "can" system, but desiring to increase its output, as well as the quality of its product, it adopted the "plate" system, and the plant it has installed is one of the most interesting in the world.



Splitting up an Electrically-Made Cake of Ice.

Interior of the Plant, Showing Tank to the Right with Cake of Ice Being Lifted by the Electric Crane.

Carrying a Cake of Ice to the Tip Table with the Electric Crane.

ICE-MAKING BY ELECTRICITY.

In Niagara Falls the popular power for the operation of factories of all kinds is electrical power, and the Cataract Ice Company has installed a 100-horse-power, 2,200-volt, Westinghouse induction motor to operate an ammonia compressor; a 5-horse-power motor of the same type, 220 volts, that operates an air compressor; a 3-horse-power motor of same type and voltage that operates the brine pump; and a 5-horse-power motor to operate an electric crane. The electric current is received from the Niagara Falls Hydraulic Power and Manufacturing Company at 2,200 volts, and for the operation of the small motors this voltage is stepped down to 220 volts.

In this Niagara Falls plant the tank occupies a space of 98 feet long, 15½ feet wide, and is 9 feet 9 inches high. This tank is divided into eight compartments, each compartment containing four plates. One of these eight compartments is emptied daily, taking out eight cakes of ice, the approximate weight of each cake being about four tons; so that the plant has a daily capacity of about thirty-two tons. The weight of the daily output varies, of course, according to the thickness of the ice. Each cake of ice made is about 15 feet 3 inches by 9 feet 6 inches wide, clear and transparent. Into each cake of ice, about six feet apart, two iron rods five feet long and about one inch in diameter are frozen, and in drawing the ice these rods are engaged by hooks at the ends of chains on the electric crane. After being raised from the compartment where it was made, each cake of ice is conveyed by the crane to the rear of the building, where it is placed on a tip table and dropped to a horizontal position. At the present time saws operated by hand are used to cut the ice into small cakes, but an electrically-operated saw is to be installed. Out of each of the huge cakes 32 small cakes are made, and these are chuted to a storage room, where the ice is kept for delivery to the company's many wagons. The plant has a storage capacity of 3,000 tons.

It is evident that in a plant of this kind, the dangers that arise from using ice from streams that are polluted by sewage are avoided. It may be claimed that natural ice is just as good as ice artificially made, if the water supply is pure in the stream or pond from which the natural ice is taken. In the plant of the Cataract Ice Company, the water is taken from the city mains. It passes through a condenser and is pumped to the top of the building, where it is discharged into a tank of large capacity equipped with live steam coils. Here the temperature of the water is raised to 160 degrees, and by gravitation the water passes down through a flat cooler, which reduces it to a temperature of about 90 degrees before passing through the filters, which have a capacity of about 15,000 gallons per day. From the filters it passes to the fore-cooler, or water storage tank. From this tank it passes, as it is used, by gravitation to the freezing compartments.

In the operation of the plant, the anhydrous ammonia is compressed, and thereby heated and converted to a gas. It is then passed to a condenser, where it is brought into contact with cold water, thus reducing it in temperature to the temperature of the water, and converting it back to a liquid. It is then expanded into the freezing coils, which are incased in the freezing plates. These plates being submerged in the water, the ice forms on their outside, and after a period of eight days a cake of ice has developed or grown. The system used is known as the direct expansion system, but by it the trouble with old direct expansion plants is obviated by the introduction of a reserve line, which is used in thawing off. After the hot gas has passed through the coils within the plates in thawing off the cakes from the plates, it becomes liquefied. It is then conveyed by use of this reserve header to another compartment, where it is expanded into the coils. It will be observed that in thawing off the plates are used as a condenser. This eliminates the possibility of the liquid gas going back to the compressor, which was the difficulty met with in operating the old style of direct expansion plate plants.

The ice made in this plant has good lasting and refrigerating qualities. As it takes eight days for a cake of ice to develop, it is evident that could the period of freezing be reduced, the plant investment would be materially lessened. Experts are now trying to accomplish this.

HOLLOW CONCRETE BUILDING BLOCKS: THEIR MANUFACTURE AND USE.

BY L. B. POWELL.

The comparatively recent advent of hollow concrete blocks into building construction is probably one of the most important innovations in the building industry, and one that is yet in its infancy. The use of concrete as building material is not recent, however, as there are still in existence dikes, dams, roadways, etc., built by the Romans of material corresponding almost exactly with our present-day concrete; it is the introduction of the hollow concrete building block machine that has made possible the gigantic strides taken by this new industry. Experiments along this line have been in progress for many years, but it is only in the past few years that the results have been tangible.

The final position of machine showing block automatically delivered, away from the molds, in a position to be carried away for "curing."

AUTOMATIC BLOCK MACHINE FOR MAKING HOLLOW CONCRETE BUILDING BLOCKS.

The natural cement which was formerly used in concrete construction has been almost entirely replaced by its superior, artificial cement, and it is only with the latter cement that any advantageous results have been accomplished. It is interesting to note that where formerly a European Portland cement was specified as the standard of excellence, in recent years American Portland cement has been so improved by exhaustive and expensive experiments that the domestic production is now conceded to be superior in every way to the foreign article. That an industry so new to this country, and one requiring so high a degree of technical knowledge, has leaped to first place, is doubtless due to the superiority of both raw material and method of production. Probably the best proof of the superiority of our product will be shown by a comparison of our production in 1890 of 300,000 barrels with that in 1903 of 21,000,000 barrels.

Concrete, as is well known, is a perfect mixture of an aggregate, such as crushed stone, with sand and cement, the aggregate forming the body of the mass, while the sand fills up the voids between the aggregates, and the cement fills up the voids between the grains of sand. As the purpose of the concrete is to take the place of stone, it is therefore necessary that the mixture be so perfectly proportioned that each aggregate and each grain of sand has a coating of cement paste, so that when the block has dried thoroughly, the mass will be held in perfect rigidity by the hardening of the cement bond. The aggregates used may be of either gravel, crushed granite, quartz, or trap rock, and should be clean and free from dust, clay, or iron rust, which will resist the adhesion of the cement bond. The sand should be as pure silica as possible, should be washed clean to be free from lime, vegetable matter, etc., and should be as sharp as possible. The proportions used in the mix will de-

POWER MIXER FOR MIXING CONCRETE.

LAYING HOLLOW CONCRETE BUILDING BLOCKS.

pend on the sizes of the sand and the aggregates, and can only be determined by testing. This is one of the most important items to be considered, and none of the proportional rules laid down by the manufacturers of hollow concrete building-block machines should be followed, but the proper proportions should be determined by careful and repeated tests, measuring each ingredient carefully until a perfect mix has been secured. Power mixers should be used wherever possible, as by their use a more thoroughly uniform mix can be secured; and where there are any number of blocks to be made, the power mixer will be found to be not only the best but the cheapest, as the time and expense of mixing are considerably reduced thereby, while the quality of the mix is far superior to that of hand mixed. However, where hand mixing is found advisable, the aggregates should be spread evenly over the mixing board at a uniform depth, the sand spread over this, and the dry cement over the sand. Then this should be turned over at least three times, which should result, if properly turned, in the mass being free from streaks. Then the mass should be sprinkled and turned three times more, sprinkling at each turn, and then smoothing over to test for streaks. If streaks should appear, turn until they disappear. Lime is sometimes used to give a white finish and produce a hard waterproof block, but when it is considered that the life of lime is only from six to sixteen years, while good concrete should last forever, it will readily be realized that a block containing lime will in a comparatively short time crumble and deteriorate. In a like manner the use of vitriol, sodium, soda, argol, salt, and other chemicals should be discouraged, as while they tend to harden a block in a shorter time, their life is short compared with the life of a good concrete building block. A good waterproof block may be made by mixing five per cent of dry powdered alum with the dry cement and ten per cent of a saturated solution of common washing soap with the water used in making the concrete. This will not affect the life of the block in any way, and will result in a perfectly waterproof block being turned out.

With so many different styles of machines at such contrasted prices on the market, it will doubtless be a matter of uncertainty which make to use, and on this point the writer, for obvious reasons, cannot advise. The principle of the process is identical with that of molding, the block being nothing more than a quantity of concrete tamped in a mold and dried. A carpenter could in a few hours make a block mold from wood that would form the first blocks in a satisfactory manner, but the mold would soon be sprung out of shape upon subsequent tamping of the blocks.

The principal reason for buying a machine at all is to secure some means of making your blocks in as economical a manner as possible, at the same time securing one that will produce perfectly satisfactory blocks. It would therefore be best to secure a tried machine, that has been in use long enough to demonstrate its value both as regards quality of product and also rapidity of production, as upon these depend the ultimate success of your venture. The only reason one would have need to buy a block machine would be to secure the advantages of labor saving, high quality of product, and rapidity of production, and for that reason the best machine on the market is the cheapest at any price. Many machines are so constructed that the block is formed face downward, so that the face of the block can be made of somewhat finer material, that can be waterproofed and colored to suit the requirements of the users. On such machines it will be found possible to make the face hard and waterproof without waterproofing the entire block, which is indeed not necessary if the block is made with a waterproof face; also, it will be found possible by using a specially-prepared and colored mix for the face of the block, to produce blocks of any desired color. After a layer of facing is placed in the machine, concrete is filled in and tamped by layers, the tamping being done either by hand or by power tamps. This is an important item, and one that must be considered carefully, as poor tamping will spoil blocks perfect in mix and mold. Pressure will not form good blocks, as under pressure the concrete will be made compact at the top and bottom in thin layers, which will act as a seal to prevent the air from escaping. Continued pressure will compress the air, and when the pressure is removed, the air expands, forcing its way through the particles of sand and making a weak, porous stone, easily subject to disintegration.

Light and frequent tamping, however, works the air out and packs the grains of sand tightly in the voids of the aggregates. When the mold is well filled and tamped, the block should be released from the machine and set aside to be cured. At this point it will be wise to remember that a newly-made block has no more strength than so much damp sand, and it should not be disturbed by handling after being molded, as a crack once started will never unite, and will utterly destroy the value of the block as a building factor.

As soon as the block has set enough to prevent the surface and corners being washed off, the sprinkling should begin, and the block kept well sprinkled for the first day. After that time it should be covered with hay, straw, burlap, or any material capable of retaining moisture, and this covering kept moist for six days. If this is not possible, the blocks should be sprayed by a flowing stream continuously for that time. It should always be remembered that the interior of the block is wet through and through by the nature of the mixture, and to insure uniform crystallization, the exterior should be as thoroughly moist as the interior. After having been cured for seven days in the shade, the block should be placed in the sun and dried for ten days, after which time the block will be ready for use on the wall. A well-made block will easily have a tensile strength of 240 pounds to the square inch and a crushing strength of 1,000 pounds to the cubic inch, thus proving itself far superior to brick, while it is now well known that concrete building blocks will outlive any kind of natural stone. On an improved automatic machine four men can make in one day blocks that will equal 6,000 bricks, wall measure. These blocks can be laid in one-third of the time required to lay the same wall measure of brick, and by inexperienced labor, with one-quarter of the mortar required for the brick. The hollow concrete building block has the decided advantage of insuring a good circulation of air inside the wall to prevent dampness, and presents possibilities, by its method of manufacture, that are peculiar to no other building factor. Cut stone of any nature can be imitated so successfully as to defy detection, and an imitation brownstone house can be made from concrete blocks cheaper than an ordinary brick house. The three main things to consider in this manufacture are mixing, tamping, and curing, careful attention to these three points going far to insure the best quality of product.

Fires from Moving-Picture Exhibitions.

BY BAXTER MORTON.

The increased use of moving-picture apparatus for exhibition purposes in recent years has been accompanied by a large number of more or less serious fires traceable to the moving-picture apparatus or to the wires used for supplying electric current for the apparatus. The disastrous character of some of these fires has attracted attention in many quarters to the importance of placing proper restrictions upon the use of moving-picture machines and of so constructing moving-picture apparatus that neither accident nor careless handling can lead to a conflagration. In a number of cities ordinances have been passed requiring all users of moving-picture machines to have their apparatus officially inspected and approved before a permit for its use can be obtained. Such inspections have been required for a considerable period in New York and Boston, and recently an act has been passed by the Legislature of Massachusetts placing all moving picture exhibitions in that State under the control of the State police. The need of such an act was clearly shown by the occurrence within six weeks of fires due to moving-picture exhibitions in Haverhill, Salem, and Lynn, which resulted in damage amounting to $60,000 and caused many persons to be seriously injured.

In a few instances, the fires resulting from moving-picture exhibitions have been due to defective or improper electric wiring, especially to the use of wires too small to carry safely the current ranging from twenty-five to thirty-five amperes, required for the successful operation of a moving-picture machine equipped with electric lighting devices. But most of the disastrous fires that have had their origin in moving-picture exhibitions have been due to accident or to the carelessness of the operator, and it is the principal duty of the officers charged with the inspection of moving-picture apparatus to see that the apparatus used in every exhibition is of such character that neither of these causes can give rise to a conflagration.

The danger attending the use of moving-picture apparatus is due to the highly inflammable character of the celluloid film bearing the pictures and to the intense heat produced where the light is condensed upon the film. This heat is sufficient to ignite the film at the projection aperture if the light is allowed to rest continuously upon one portion of the film for a few seconds, but when the machine is in operation the film of course travels so rapidly across the projection aperture that the heat is without effect upon the film. The projection aperture, therefore, is the point at which the film is most apt to take fire, and in almost every instance the ignition takes place because a portion of the film is held stationary at the projection aperture for a time. This may be brought about in various ways. The film may break below the projection aperture; the feed mechanism may become jammed and inoperative; it may lose its hold on the film; the crank may become loose on the shaft of the feed mechanism so that its turning will not feed the film forward; a small fragment may be torn off the film and lodge in the projection aperture where it will be exposed to the full heating effect of the light; or the operator may stop turning the crank of the film feed mechanism for any one of a variety of reasons. He may become faint or giddy from the heat or from escaping gas; his attention may be suddenly distracted and he may forget to keep the film feed mechanism in motion; or he may stop the feed of the film intentionally and neglect to cut off the light. Fires have resulted more than once from each of the foregoing causes, and it is practically impossible to construct moving-picture apparatus in such a way as to prevent the film from occasionally taking fire at the projection aperture. It is possible, however, to prevent serious consequences from the ignition of the film at this point, and this may be done by simply preventing the fire from following the film from the projection aperture to the reels upon which the film is wound. Ordinarily, these reels have from eight hundred to twelve hundred feet of film wound on them, consequently, if a flame reaches either of these reels the fire that results is so large, so hot and so difficult to extinguish that great damage to the building is almost certain to result, to say nothing of the panic that is always caused when a flame of any size breaks out in a place of public entertainment. If, however, the film burns only at the projection aperture, the flame will be small and do no damage. To limit any fire that may occur from a moving-picture exhibition to a few inches of the film, it is only necessary to inclose both the film supply reel and the take-up reel in fireproof chambers and to provide valves leading into said chambers through which the film can pass freely while the film feed mechanism is in operation, but which will close instantly when the film feed mechanism ceases to operate or the tension upon the film is relaxed. If the film supply reel and take-up reel are inclosed in such fireproof chambers or magazines, the ignition of the film at the projecting aperture is a matter of very little consequence, as the burning of the film at that point immediately causes a reduction of the tension on the film and permits the valves through which the film passes into the magazines to close and so prevent absolutely the passage of the flame into the magazines. Properly constructed magazines for the film supply reel and take-up reel can be applied at very small cost to any moving-picture machine, and if the machine is equipped with such magazines it may even be overturned without causing any serious damage.

Other methods of preventing flames at the projection aperture from reaching the reels of film have been proposed, such as a non-inflammable plate of considerable size arranged above the projection aperture and extending rearward and to the sides for a considerable distance. Such a plate will sometimes prevent a flame at the projection aperture from reaching the film on the supply reel, but it is by no means as certain in its action as the magazines already mentioned, for the film above the plate is fully exposed, and if the flame rises above the edge of the plate it may strike the exposed film and set fire to the entire reel. Another device which has been proposed to prevent the transmission of a flame from the projection aperture to the film reels consists of a pair of flat tubes or guides extending above and below the projection aperture and made of non-inflammable material, the idea being that in the small space afforded by these guides for the passage of the film a flame will be extinguished. As a rule this device operates successfully, but as the reels themselves are exposed, a flame flaring up suddenly at the projection aperture may reach one of the film reels in spite of the guides.

A plan of preventing fires from the use of moving-picture apparatus that has been adopted in England to a considerable extent is to inclose the entire apparatus in a fireproof box large enough to contain the operator also and to lock the operator in during the exhibition. This plan has the merit of making operators careful, but many grounds of objection to it are obvious, and American operators of moving-picture apparatus are unwilling to be locked in such a box while giving an exhibition.

Considered from all points of view, the most satisfactory and thoroughly reliable means for rendering moving-picture apparatus safe is a fireproof magazine for the film supply reel and a similar magazine for the take-up reel. Such magazines answer all the requirements and have the advantage of being readily portable and of being easy to apply to any standard moving-picture machine.

The earliest wooden bridges were built by expert carpenters. The work was done by contract, very much the same as building work is done at the present day, except that the builder was also the designer. The builder would buy suitable timber or have it sawed to order at conveniently located saw-mills, and any ironwork needed in the construction of the bridge, such as rods, bolts, or bars, he would obtain at a local blacksmith shop, and frame and erect the bridge in place, ready for traffic. The same methods were also used in building the early iron highway bridges. Each of these builders had his own type of bridge and his own special details. At that time there was generally but little competition, as very few had any knowledge of bridge building, and each one controlled a certain territory.

Correspondence.

Where Did the Photographer Stand?

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Crawford's method (July 1 and 15) of finding the inclination of the picture plane from the convergence of the mortar lines in the front of the transit room did not appear to me to give satisfactory results. In fact, his measures made upon the cut shown on June 10 put *V R*, the east vanishing point, at a distance of 347 feet to the right of *O*, while mine made upon the original photograph would put it only 278 feet away. Owing to their small convergence, I made no use of these lines at all, but resorted to the method of first supposing the picture plane parallel to the front of the observatory, and thereby obtaining the distance of the camera, and then in my concluding paragraph showing that the error of this assumption did not vitiate the results in practice in this instance. This supposition of parallelism affected only the values of *A O* and *A B*, which, strictly speaking, were not reduced in the same ratio by the inclination of the plate; but as the difference was less than the unavoidable errors of measurement upon a photograph, I judged it best in practice to neglect it in this instance.

The cut shown on June 10 is in point of size 59 per cent of the original photograph. It was not made directly from the latter, but only indirectly, that is, from another photo-engraving. This will sufficiently account for the difference between Mr. Crawford's and my results. WILLIAM F. RIGGE.

Creighton University Observatory, Omaha, Neb., July 16, 1905.

Partial List of Form Elements Found in Croton Water.

To the Editor of the SCIENTIFIC AMERICAN:

On one day, July 25, 1905, the following are the form elements observed in Croton water in order of finding: 1. Gomphospheria abundant and throwing off spores. 2. Melosiræ, diatoms. 3. Naviculæ, ditto. 4. Cocinodiscus, ditto. 5. Arcella mitrata. 6. Gromia. 7. Anabaina circinalis. 8. Pelomyxæ. 9. Pediastrum com. 10. Oscillatoriaceæ. 11. Plagiophrys. 12. Volvocinæ 13. Bast fiber. 14. Humus. 15. Decayed woody fiber. 16. Coelastrum sphericum. 17. Starch grains. 18. Amorphous masses of dirt, many. 19. Plagiophrys, another variety. 20. Large cross-barred diatoms, new. 21. Pediastrum incisum. 22. Vorticella. 23. Anurea stipitata. 24. Red water fungus. 25. Large masses of vegetable epithelia. 26. Silica. 27. Amphiprora prorata. 28. Scenedesmus quadricauda. 29. Large number of double spores of alga, new to observer. 30. Staurastrum gracile. 31. New tetraspore. 32. Scenedesmus obliquus. 33. Cotton fiber. 34. Skeleton arm of a large entomostraca. 35. Monad. 36. Peridinium candelabrum. 37. Two-eyed Bosmina, heart seen plainly beating 120 per minute. Before this time one eye was the rule. 38. Wool fiber. 39. Smooth spicule of sponge. 40. Pediastrum boryanum. 41. Part of hydra. 42. Difflugia cratera. 43. Arcella mitrata with minute processes projecting all over like cilia. Never noticed before in twenty-five years. 44. Polycoccus. 45. Cosmarium binoculatum. 46. Difflugia cratera, another commoner variety.

No one is more impressed than the writer with the imperfection of this list. It should be remembered that Prof. P. F. Reinsch, of Erlangen, said that only about one-half of these were named. Those who can are invited to add to the list, and in case none do so, we advise to send for Prof. Reinsch, who is the most capable man in the world to do this needed work.

New York, July 26, 1905. EPHRAIM CUTTER.

The Reasoning Power of Animals.

To the Editor of the SCIENTIFIC AMERICAN:

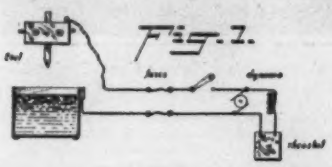
Under the above title in your issue of July 22 a correspondent says that cats that open doors by pulling on the thumb-latch or pawing knobs, or ring door bells to be let through the doors, "do in no way show reasoning power, but on the contrary it was an act of dumb imitation." Quite likely we disagree, because we give different definition to the word "reasoning." But call it "dumb imitation," if you please. To imitate, the cat had to observe how people opened doors. That required thinking. It observed for a purpose; more thinking. It wanted to pass through the door, it remembered how it had observed the door was opened, it resolved to try the same method, and it succeeded. Now here is a series of thoughts, a process of thinking from cause to effect, that to my mind is just as logical reasoning as if performed by a human being. The act was not prompted by instinct, because the cat family has not inherited the practice of opening doors. Your correspondent intimates that it came from intuition. I had supposed that intuition was a God-given faculty, possessed by only a few favored men and women who do not have to stop to reason. He admits that elephants and beavers reason, but denies that power to the cats that have been mentioned, because a certain bear appears to be continually trying to escape from its cage. I see no force in that argument. And I had also supposed that animals confined in cages walk to and fro more from restlessness than from efforts to escape. If they were constantly trying to get out, they would frequently try to break the bars of their cages, but they have long since learned that they cannot do that, and so seldom try. Such animals in their natural state lead active lives; confined in cages, their natural physical activity forces them to a kind of unconscious exercise which is a relief to restraint.

From reading various works I have got the impression that psychologists are quite generally coming to the conclusion that man and the other higher mammals do their thinking with the same kind of machine—the brain; and the amount of reasoning each does depends quite largely on the size and quality of that machine. And animals that learn of themselves how to do things by observing how human beings do them must do some thinking from cause to effect, and thus use more or less reasoning power. I have found three people in this city who have cats that open doors; two by pulling on the thumb-latch, and one by pawing the knob. C. W. BENNETT.

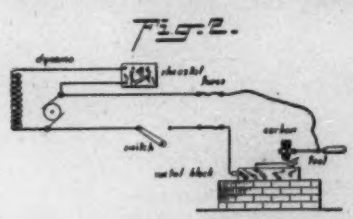
Coldwater, Mich., July 24, 1905.

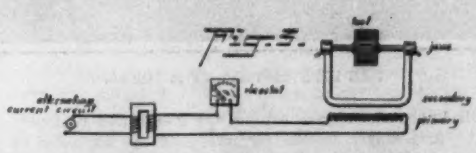
ELECTRIC TEMPERING OF TOOLS.

The following simple methods of tempering and annealing tools have been described by J. M. Gladhill. By using the electric current for the heat, we can easily carry out the operations, and the temperature



can be regulated to the right point. One of these apparatus is represented in Fig. 1. It consists of a sheet iron tank of suitable size containing a concentrated carbonate of potash solution. The tool to be tempered is mounted in an appropriate socket or holder which is connected with the positive pole of the dynamo. The circuit is closed by the metallic tank. Switches and regulators are placed in the circuit. The tempering operation is carried out in the following manner: The circuit being closed, the tool is plunged slowly into the bath so as to dip the part which is to be tempered. This part heats up under the action of the current. When the right temperature is judged to have been reached, the current is broken suddenly and the tempering takes place in the liquid of the bath. The electric arc may also be used for the same purpose. Fig. 2 shows the arrangement which is used in this case. The tool to be tempered is placed upon a support of fireproof material which is also a poor conductor of heat, and the arc is started at first at a low tension between the portion of the tool which we desire to temper and a carbon electrode placed near it. The tension is increased by working a rheostat until we obtain the necessary heat, but overheating or melting of the tool is avoided. As a source of current we use a direct current dynamo which will give a tension varying from 50 to 150 volts. The dynamo is operated by an electric motor working at 220 volts. In this way it is possible to produce arcs varying from 10 to 1,000 amperes by working the rheostat which the ex-





citing current of the dynamos carries. The electric method can also be used with success for annealing. This applies to tools of special form such as gears, dies, and in general to all tools where we need to have a hard temper on the outer part while the inside has a great tenacity. Generally the annealing is carried out by introducing a heated rod into the hollow tool. But this process is defective both on account of the difficulty of keeping up the temperature for a long enough time and also from the cracks which may occur from a too rapid heating up. With the electric process which we illustrate below, such accidents are not to be feared, since the rod is introduced when cold and it is heated up gradually. We are thus able to keep the temperature at the right point during the whole time which the annealing requires. This apparatus is represented in Fig. 3. We employ a transformer which lowers the tension of the alternating current to 2 volts. The secondary coil of the transformer is formed of a copper bar of large section which is connected to each end of the form carrying the tool. We regulate the strength of the current and consequently the temperature of the holder by the use of a rheostat, and thus we can obtain a perfect adjustment of the temperature during the process.—L'Electricien.

Engineering Notes.

Steel as a structural material was first used in a portion of the St. Louis Bridge, completed in 1874, but the first bridge built entirely of steel was the Glasgow Bridge, over the Missouri River, completed in 1879. The extensive use of steel, however, did not commence until 1890. Before that time steel was used only in isolated cases, or for heavy work, such as chords and eyebars for large spans.

Centrifugal pumps were known as early as the seventeenth century. Papin, the celebrated French engineer, designed a centrifugal pump in 1703. Euler brought out a pump of this type in 1754. In 1818 a form of centrifugal pump was brought out in Massachusetts, known as the Massachusetts pump. In 1830 a Mr. McCarthy erected a pump in the New York navy yard which was credited to have approached the efficiencies of the present day. In 1846 Andrews produced pumps of this type, and about this same time John and Henry Gwynne of England commenced the manufacture of centrifugal pumps as a commercial enterprise. Appold exhibited a model of a centrifugal pump at Birmingham in 1849, and at the Crystal Palace Exposition in London in 1851, Appold's pumps were an important feature.

After iron railroad bridges had been in service for about twenty years, engineers who had charge of their maintenance noticed that weak points developed under traffic, particularly in the details and connections. It also became apparent that the bridges built up to about 1875 were deficient in rigidity and lateral stability, and improvements were gradually made to remedy these defects, producing more massive construction, fewer and heavier parts, and a more extensive use of riveted connections. The pin-connected type of truss for short spans was gradually discarded, the plate girder and riveted truss taking its place, and the limiting length of spans for these types was gradually increased. Specifications for iron bridges were also revised and improved; those prepared in 1877 by Charles Hilton for the Lake Shore and Michigan Southern and by C. Shaler Smith for the Chicago, Milwaukee & St. Paul Railroad, and 1879 by Theodore Cooper for the Erie Railroad, being steps in that direction.

The Failure of Ludlow's Airship.

Israel Ludlow attempted thirteen times on July 25 to send his new creation high into the skies at Seventy-eighth Street and the North River, New York city, and finally when the craft turned over on its back it was decided that the machine could not fly in its present form. The apparatus was described a few weeks ago in these columns by Mr. Ludlow himself. Once the flying machine attained an altitude of sixty feet and then it dropped into the midst of the crowd, which scattered to the sand piles and the tall grass with promptness.

Philip Campbell, a Philadelphia aeronaut, offered to sit in the machine and take chances on its leaving the ground. The car was adjusted and a seat made for him to sit on, but instead of rising from the ground the bamboo framework with the shaking wings skidded rapidly along the ground with Campbell waddling in the center. Twice more Campbell vainly essayed the flight in the air, but never rose an inch.

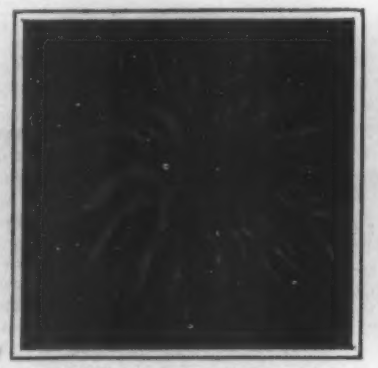
Then some tests without any person in the machine were made, and on the twelfth trial the airship rose majestically sixty feet in the air, soaring like a gigantic box kite. Then, just as it was sailing finely in the air, Mr. Ludlow let go of the rope which he held, and the airship, twisting and twirling, fell into the midst of the watching crowd.

The Current Supplement.

The current SUPPLEMENT, No. 1544, has a striking front-page illustration showing a race between a steam locomotive and a powerful electric locomotive, which has just been built for the New York Central and Hudson River Railroad. The Cerebotani autotelegraph, an article contributed by the Belgian correspondent of the SCIENTIFIC AMERICAN, describes an important invention, having for its object the direct transmission of writing. The English motor omnibuses for city and country use illustrate some interesting types of public conveyances. The article on the construction of a silver glass telescope 15¼ inches in aperture, and its use in celestial photography, is continued. The usual electrical notes and science notes, etc., will be found in their accustomed places.

THE LIFE HISTORY OF A CORAL.

Although many of us may know a coral when we see it, it takes a zoologist to tell us what it is. To him a coral is a hard, chalky skeleton secreted by certain polyps for their support and protection. Coral polyps are closely allied to sea-anemones or actinians, only in these no skeleton is formed. Sometimes the coral structure branches like a shrub, or spreads out like a fan; sometimes it assumes the appearance of a human brain, or of a flower or mushroom. The skeletons often form reefs varying in length from a few yards to hundreds of miles, as in the Great Barrier Reef of Australia. They may also produce coral islands, frequently occupied in the middle by water, when they are called atolls. In a general way, the books tell us that the coral-producing polyps form colonies which increase by gemmation (budding). In this process young polyps spring from the original polyp, sometimes indifferently from any part of its surface, sometimes only from its upper circumference or from its base. These buds do not separate from the parent polyp, but remain and give rise to buds in turn, the whole producing what is known as a colony. Reproduction by division or fission is also a very general process in the growth of coral masses.

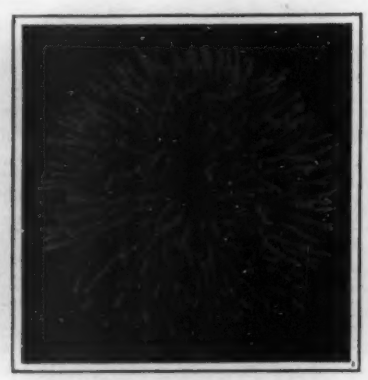


West Indian Sea Anemone (*Condylactis passiflora*).

The resemblance to a coral polyp is apparent.

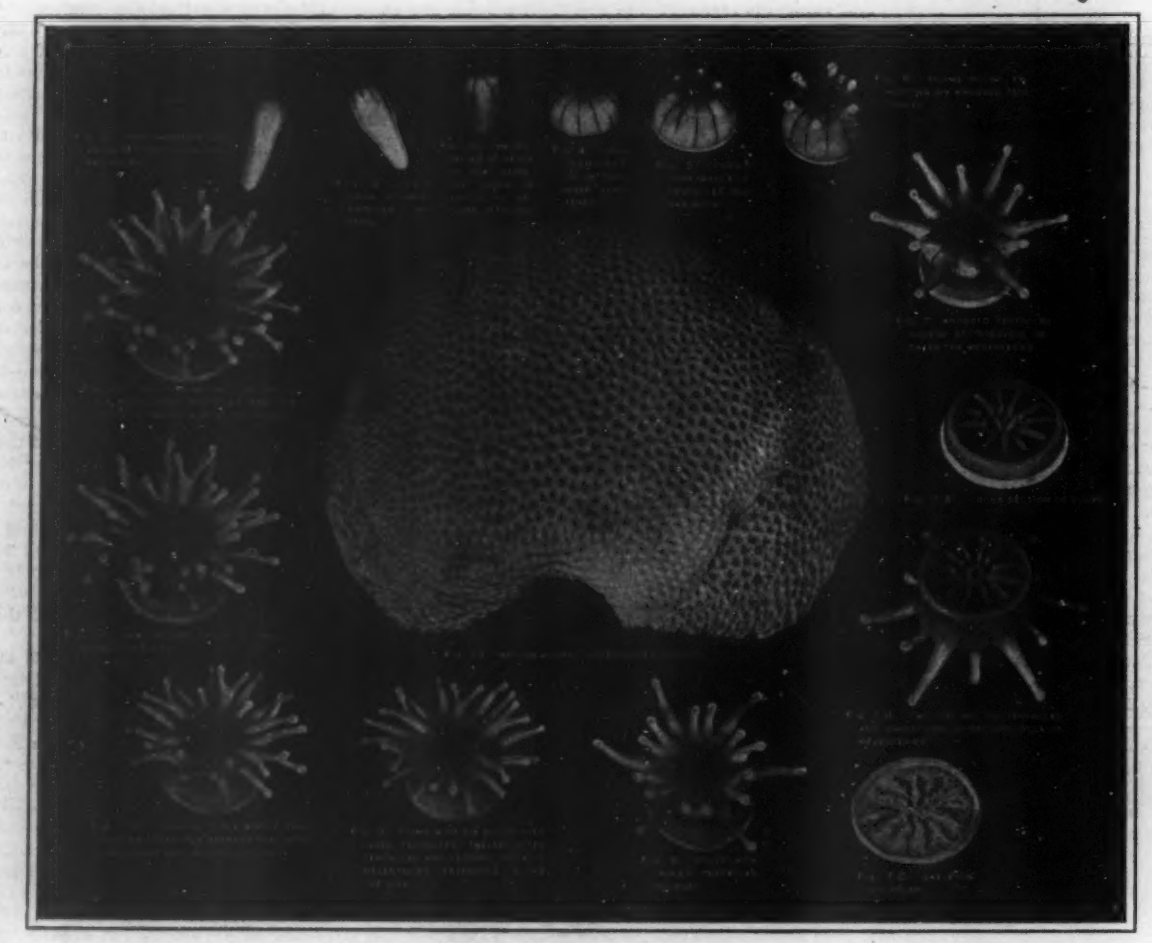
A Portion of the Mature Coral (*Siderastrea radians*) Enlarged.

Four expanded polyps (one partly contracted) are shown; also a polyp in cross-section and the skeleton (secreted by the polyp). The cross-section shows the mesenteries of the polyp alternating with the septa of the skeleton.



A Mushroom Coral of the Pacific Showing Resemblance of a Coral Polyp to a Sea Anemone.

This coral consists of a single polyp and its secreted skeleton. In the center is the mouth, surrounded by tentacles.



THE LIFE HISTORY OF A CORAL.

In order to show how a coral develops, the American Museum of Natural History has placed on exhibition a series of splendid wax models made under the direction of Dr. D. E. Dahlgren, head of the Museum's Department of Preparation, on the basis of researches carried out by Dr. J. E. Duerden in Jamaica. The accompanying illustrations are photographic reproductions of the models in the museum. The coral selected is a West Indian form known as *Siderastrea radians*. The Carnegie Institution, of Washington, has recently published a monograph by Dr. Duerden, in which the complete process of development of a coral is described. Its life-history may be considered as fairly typical of the life-history of most corals, though certain details with regard to the development of the tentacles are perhaps characteristic of the species.

A coral colony has its beginning in a simple larva set free from the parent polyp and is usually just large enough to be visible to the naked eye. Such a free swimming larva of an elongated, pear-shaped form, is shown in Fig. 1, of course much magnified. As it swims or drifts about, one end of the larva swells or thickens, and four pairs of striations begin to appear, clearly shown in Fig. 2. The external striations give evidence of an internal division of the hollow cavity of the larva and are the first signs of the mesenteries (partitions). Soon the rudimentary mesenteries increase in number to six pairs (Fig. 3) and about this time the larva settles to the bottom of the sea, attaching itself to some rock or stone, perhaps to some old piece of coral. A change of shape now takes place, more pronounced than any of the preceding structural modifications. Now permanently secured, the base of the larva flattens until the organism resembles an open umbrella in form. The larva may now be called a polyp. Fig. 4 depicts the individual at this stage and also reveals the developing mesenteries radiating from the mouth. It is through this mouth that the animal receives nourishment and also gets rid of its waste matters. Around and under the base of the polyp a very thin layer of lime is now secreted by the activity of the cells. This is the beginning of a skeleton. Six knobs also appear around the mouth and represent the first stages in the formation of the tentacles or feelers (Fig. 5). They push their way upwardly like so many seedlings (Fig. 6). As they continue to grow and increase in size, they develop into true knobbed tentacles characteristic of coral polyps (Fig. 7). They appear at regular intervals between or alternating with the mesenteries. Another set of six tentacles appears in the spaces between the first six, making the number thus far attained twelve. Then at the base of the second set, a third series of six sprouts out, as illustrated in Fig. 8. In Fig. 9 the inner tentacles are now shown doubled. Next (Fig. 10) we find the polyp equipped with six bifurcated inner tentacles and twelve outer tentacles; moreover, a second cycle of six pairs of mesenteries faintly traces its course along the disk. In the following stage a cycle of six simple tentacles appears between the original first and second cycles (Fig. 11), and soon the polyp doubles its second cycle of tentacles (Fig. 12). Finally, we find two cycles of six bifurcated tentacles and one cycle of twelve simple tentacles, all situated over the internal chambers produced by the presence of the mesenteries or partitions.

Thus the polyp develops by gemmation, tentacle crowding on tentacle. The young animals form skeletons from the parent polyps, the new skeletons literally growing out of the older ones. It is evident enough how, by a process with such immense possibilities of multiplication, a large area can be rapidly built up.

Under the special conditions necessary for the growth of a coral, it is a matter of interest to discover by what means the reefs and atolls have been formed, that often rise from depths of several hundred and even thousands of feet. According to Darwin—the first man who clearly recognized how essential is shallow water to the development of a coral—polyps colonized along the shores of an island to form eventually a fringing reef. Assuming a slow subsidence of the ocean floor, sufficiently slow in fact to permit a continuation of growth on the outer edge of the reef, the water channel would gradually widen and deepen to form a barrier reef, which upon the submergence of the entire island would yield place to an atoll. Elaborated by Dana, this theory was promulgated in almost every text book on geology. Unfortunately for Darwin's view, however, it was discovered that some islands instead of subsiding were actually elevated. Then Murray proved that corals may grow on a perfectly stable floor, such as the slopes of a volcanic island, or submarine banks of fossil organisms. Simultaneously with this outward growth, the coral reef is washed by the sea. The debris carried down to the bottom forms a table for their future growth. It may happen that the original foundation projected above the sea-level, and might thus have been cut down by breakers. How is the characteristic ring-shaped formation produced? Simply by the solvent action of the water acting on the dead coral (which is nothing but carbonate of lime), thus forming a lagoon.

Probably both Darwin's and Murray's theories are correct; and what is more, other theories, equally plausible, may be advanced to account for the coral atoll. The truth is that each atoll has probably been produced under peculiar local conditions, and that these conditions are sufficiently alike in many cases to permit a Darwin or a Murray to formulate interesting if not generally acceptable theories.

THE NEW JAPANESE BATTLESHIPS.

The Japanese navy has now under construction two battleships, which are probably the most powerful of any built or building (if we except the one battleship recently ordered by Great Britain) for any navy. They embody the lessons of the present war, though not to the extent that would be evident, were the plans for the ships being drawn at the present time. The striking feature is that, in addition to the usual main battery of four 12-inch guns, they also carry four 10-inch guns. The 10-inch gun was the main armament on several of the destroyed Russian battleships, and is the main armament on one or two modern British battleships to-day. Therefore, it may be said that the main battery of each of the new Japanese vessels is equal to that of two battleships of some existing types.

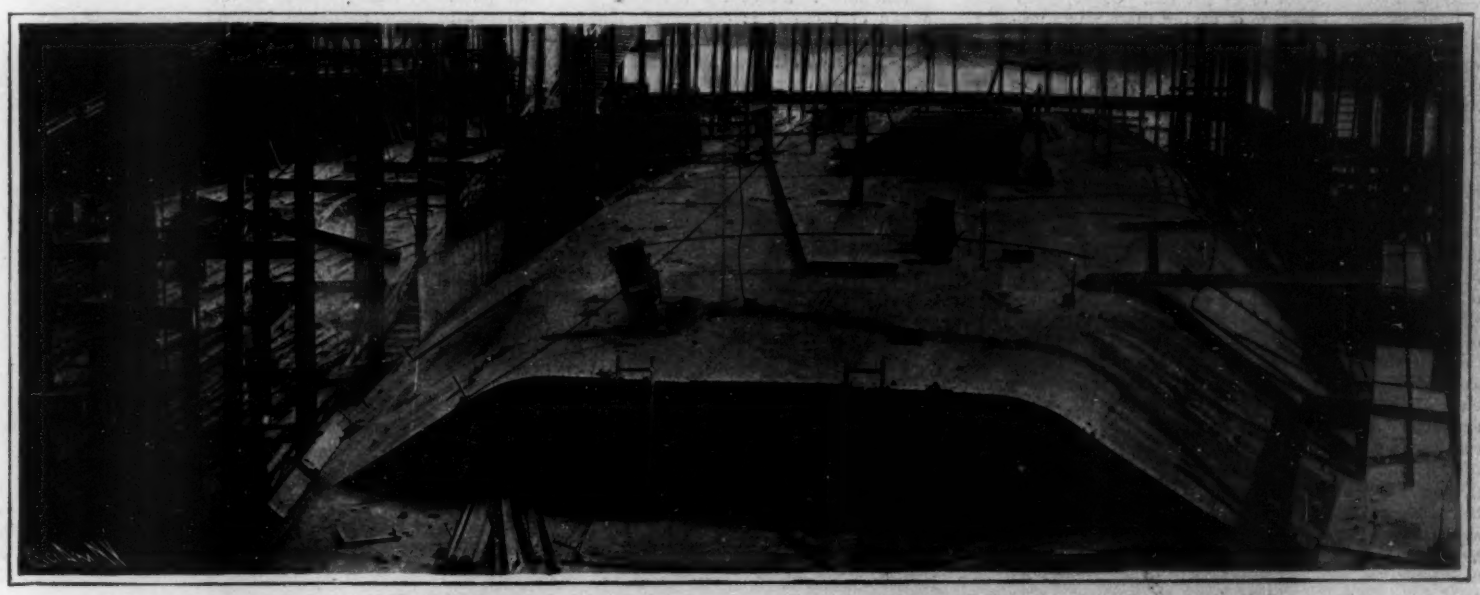
Of the two ships, the "Katori" is being built at the yards of Messrs. Vickers, Sons & Maxim at Barrow, and the "Kashima" is being built by the Armstrong firm at the Elswick yard. The "Katori" measures 455 feet 9 inches over all, 78 feet in beam, and on a draft of 27 feet she displaces 16,000 tons. The "Kashima" measures 425 feet on the waterline and 455 feet over all. Her breadth is 78 feet 2 inches, and on a draft of 26 feet 7½ inches she displaces 16,400 tons. The armament of each ship consists of four 12-inch guns mounted in pairs in barbettes; four 10-inch guns mounted singly in barbettes, one at each corner of the central battery, on the plan first adopted in our own "Oregon" class; twelve 6-inch guns carried in a central citadel; twelve 12-pounders; six Maxims; three 3-pounders; and five under-water torpedo tubes. The 12-inch Armstrong gun on the "Kashima" weighs 59 tons, has a length of 46.7 calibers, and fires an 850-pound projectile. The 10-inch guns weighs 34 tons, has a length of 46.7 calibers and fires a 500-pound projectile. The 6-inch guns will be about 47 calibers in length. Messrs. Armstrong inform us that the charge will probably be a modified cordite, and that the power of the 12-inch guns will be such that no armor that any ship carries can hope to withstand them up to a distance of three thousand yards. The 10-inch gun will have a penetrating power which will be equal at 3,000 yards to any of the 12-inch guns at present afloat in any navy. The breech-screw of these guns is arranged for a parallel motion, which does away with the necessity of having a steep cone at the seat of the obturating pad, and saves weight and length at the breech of the gun. The 12-inch Vickers guns of the "Katori" are of 45 calibers, and weigh 57 tons each. The 10-inch guns are also 45 calibers long, and weigh each 34½ tons.

The disposition of the armor in the two ships presents no features of novelty, and it is practically the same in both ships. The following description of the "Kashima" will answer therefore for both vessels: Amidships, it is carried from below the waterline up to the upper deck, above which further protection is given by a screen of 4-inch armor, which extends 7 feet 6 inches above the upper deck and covers the 6-inch gun positions amidships and also the spaces between the 10-inch gun positions. The waterline armor belt which is 9 inches in thickness amidships, and tapers 4 inches at the ends, reaches 5 feet below and 2 feet 6 inches above the waterline at normal draft. Above this is a belt of armor 9 inches thick amidships, which reaches from the after 12-inch barbette forward to the stem. Above this belt is the 6-inch citadel armor, which reaches to the upper deck and extends forward and aft to inclose the two 12-inch barbettes. Ten of the 6-inch guns are mounted within this citadel on the gun deck, and they are separated from each other by armored screens. On the main deck above, mounted midway between the 10-inch guns, are two more 6-inch pieces, one on each broadside. The armor on the barbettes of the 12-inch guns is 9 inches in thickness where it is exposed, and 5 inches in thickness where it is protected by the citadel armor. The 10-inch gun barbette armor is 6 inches in thickness, which we think is scant protection for such important pieces. The conning tower carries 9 inches and the observer tower at the after bridge, 5 inches of armor. A novelty will be the provision of two other shelters for the officers, which will be placed on the boat deck amidships, and protected with 3 inches of armor. The protective deck, the construction of which is shown very clearly in each of our views, is 2 inches in thickness on the flat and 3 inches on the slopes. Toward the ends of the ship where the thickness of the side armor is reduced, this deck is increased in thickness from 2 to 2½ inches.

Each of the big gun turrets, six in all, is provided with an independent magazine; the 6-inch and smaller guns obtain their supplies from an ammunition passage which extends around the machinery space below the waterline. Of the five under-water torpedo tubes, two are located forward and two aft on the broadside, and one tube is built into the stern and fires in line with the axis of the ship. The coal bunkers have been designed with the double object in view of giving all possible protection to the vitals, and of minimizing labor in trimming and in transporting the coal to the furnaces. The longitudinal coal bunkers at the side of the boiler rooms and below the protective deck can be kept closed during action, thereby affording additional protection against the torpedo.

Another important feature in the bunker arrangements is that the bulk of the coal can be brought to the stoke holes without opening any of the doors in the main water-tight bulkheads; moreover, reserved coal bunkers are arranged at the slopes of the protective deck up to the height of the main deck throughout the length of the machinery space. The total coal bunker capacity is about 2,000 tons. It is estimated that with about 16,000 indicated horse-power the speed of the two ships will be 18½ knots an hour.

Our illustrations of the "Kashima," taken during her construction, speak for themselves, and serve as an excellent object lesson in the internal arrangements of a



View Looking Aft on the Protective Deck, Showing the Way in Which it Slopes at the Sides to Meet the Lower Edge of the Waterline Armor.

Looking Forward on the Protective Deck, Showing the Opening for the After 12-inch Gun Barbette, and the Four Barbettes for the 10-inch Guns.

CONSTRUCTION OF THE NEW JAPANESE BATTLESHIP "KASHIMA."

modern battleship. The ship was launched last spring, and is rapidly approaching completion. The spirited photograph of the "Katori" shows this vessel as she was taking the water at her recent launch. The big chains which reach forward from the bow are cables, which are dropped at the moment of launching, and serve by their friction as they are dragged over the ground to check the ship's speed. The ship was named by Princess Arisugawa of Japan, who pulled a cord attached to the small balloon at the bow of the ship and released several pigeons, a characteristic Japanese ceremony.

By-Product Coke.

About 30,000,000 tons of coal are carbonized in beehive ovens every year, 20,000,000 tons being carbonized into coke for blast furnace use and the balance for sundry other manufacturing purposes. In this connection we would like to impress upon your mind the fact that there goes off as waste products from this 30,000,000 tons from 80 cents to $1 per ton. Consequently you can see the advantage of saving these waste products because it is not American-like to see so much waste go into the air. Our friends, the financiers, are usually after the mighty dollar, and they don't like to have it get into the air where they can't get it.

By-product ovens have been in use throughout Germany and other parts of the Continent, and largely in England during the past 25 years. There are no beehive ovens in operation in Germany at the present time.

The introduction into this country was comparatively slow at the first, but the field has greatly increased during the past three or four years. There have been built, or are in course of construction at the present time in the United States and Canada, about 3,950 by-product ovens, about 2,605 of these being of the Otto-Hoffman and United-Otto systems, carbonizing approximately 15,000 tons of coal per day, and about 1,345 Semet-Solvay, carbonizing approximately 8,000 tons of coal per day, amounting in a year to a total carbonization of approximately 8,400,000 tons. It will be seen that, although the number of by-product coke ovens apparently does not approach the number of beehive ovens installed, on account of the difference in the size of the charge and the shorter coking time, the coke made in by-product coke ovens will be much nearer the total coke tonnage of beehive ovens than would at first be supposed.—Mines and Minerals for July.

How the Ox Bow Tunnel was Cooled.

The boring of the Ox Bow tunnel in Idaho is one of the great engineering feats of the age. The Payette River at this point makes a loop, and by putting a tunnel through 1,200 feet, the river bed is left dry for two and a quarter miles. It is the intention to mine the river bed for gold. Experts have estimated its value at from $6,000,000 to $42,000,000 dollars. Ordinarily, the putting through of this tunnel would be a simple matter, but at 300 feet from the upper end and 250 feet from the lower, hot water was struck. The heat at first was from 95 deg. to 105 deg., increasing as the work progressed to 132 deg. at the hottest point. Different fans and blowers were experimented with to cool the air in the tunnel, but without success until William Flick, the superintendent of the work, thought of spraying the walls of the tunnel with water pumped from the river. Very simple pumping apparatus and common garden sprays were used with complete success. The tunnel is 28 feet wide and 9 feet high, and the flow of hot water amounted to 75 miner's inches. The cold water so cooled the hot water that it was caught in sumps and pumped out with common pumps.

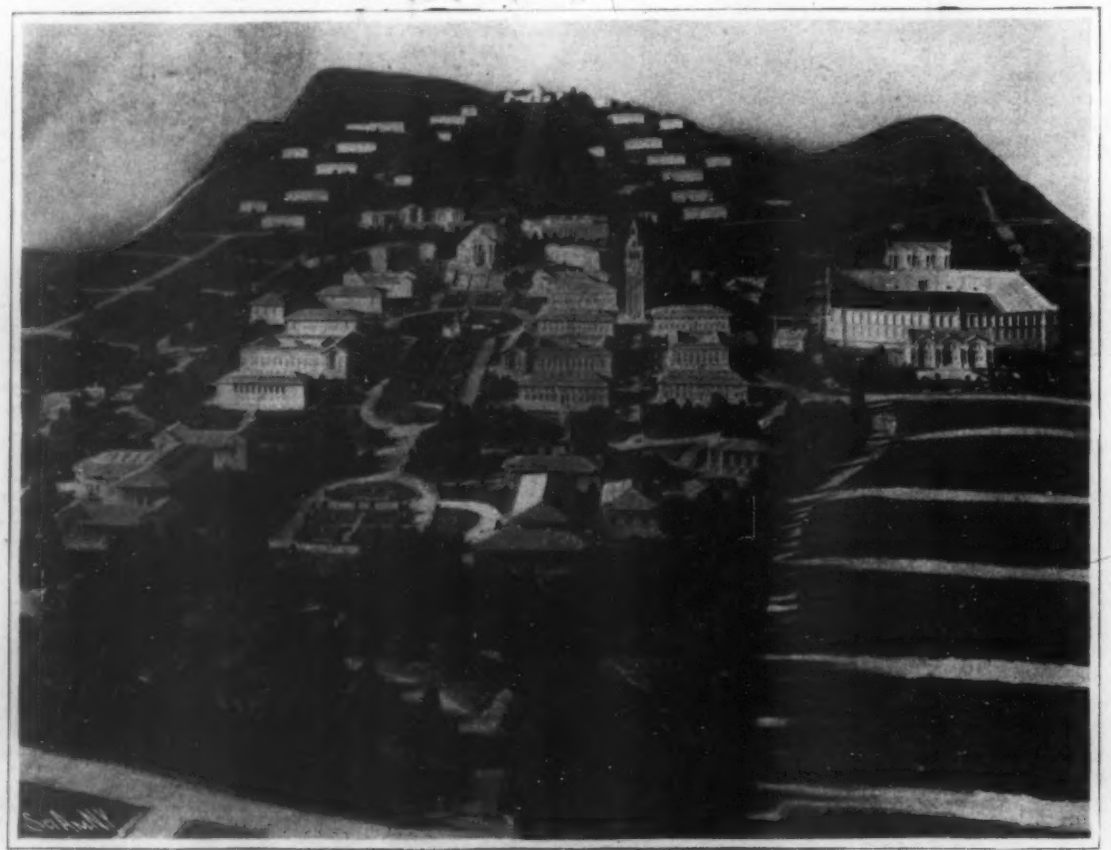
THE FUTURE UNIVERSITY OF CALIFORNIA.

BY ENOS BROWN.

Five years ago the most noted of European and American architects engaged in a competition to provide the University of California with plans and suggestions for buildings and their arrangement in reference to the site. The competition was held in Antwerp, and the response to the invitation was general. Of the number exhibited, about ten were commended for future consideration, and from these the one designed by M. Benard, of Paris, was selected as the most meritorious. The successful architect subsequently visited the university, and, in conference with the regents, his design, with some necessary modifications, was adopted and definitely settled upon as the one to which all new erections for university purposes should be subordinated.

The architect of the university, John Galen Howard, has recently completed a plaster cast of the site, with the location and detail of the buildings now being erected and of those it is contemplated building as the necessary funds are provided.

The site of the University of California is incomparable. By a gentle ascent it rises from the shores of the bay, from which it is distant about two miles. The entrance is 100 feet above sea level, but, within the grounds, the slope is more abrupt, climbing the low coast range until at the crest, upon which the observatory will stand, a height of 597 feet is attained.



CAST OF BUILDINGS OF THE UNIVERSITY OF CALIFORNIA.

The profile is undulating and the view wide. The small buildings immediately below the observatory are dormitories, and to the right of the picture are the amphitheater and, in order, the department for chemistry, physics, mathematics, clock tower, languages, library, California hall, zoology, agricultural, botany, history, library extension, physiology, and hall for alumni. The large building to the right is the athletic field and accompanying gymnasiums. To the left of the central roadway, from the top, is the dining hall, geology, mining, electrical, mechanical, and civil engineering buildings, museum, fine arts, pathology, physiology, anatomy departments, with mansion for the university president. Even on the minute scale at which the cast has been made, the architectural type and general appearance of the buildings have been faithfully shown. The structure in the central basin is the great auditorium for gatherings of faculty and students. The dome of this structure will dominate the entire group.

Considerable progress has already been made in the erection of new buildings based upon the general plan. The concrete amphitheater is completed and the president's mansion, California hall, and mining building are in a state of advancement, while funds have been provided for the new library. The older structures, that now serve a necessary purpose, will be dispensed with as soon as possible. In time the plan will be complete; and no institution of learning in the world will be so magnificently housed. It is not as yet estimated what the cost will be, but many millions will be required. The munificence of individuals with the generosity of the State are confidently looked upon to supply the necessary funds.

A Novel Smelting Process.

A novel smelting process patented by the Köln-Müsener Mining Company in Kreuzthal is receiving much attention in German engineering circles. This process is intended to be used mainly in the operation of blast furnaces, its object being to open with extraordinary rapidity any closed blasting molds or obstructed tapping holes. It further serves to dismount rapidly any kind of iron construction. It may be mentioned that about fifty mining works have already secured licenses under the patents.

The risk and heavy loss involved in blast-furnace operation whenever the tapping hole does not open normally, and the hard and oftentimes useless work of many hours in chiseling through the hardened mass with steel rods, are known to every metallurgist. There is the risk of the rising liquid pig iron reaching the water-cooled cinder molds and the tuyeres, which may result in fatal explosions and bursting. All these difficulties and risks are entirely done away with by the Köln-Müsener process, which is carried out in a few minutes, and frequently in less than one minute.

The process consists in heating the mass to be melted in one of its points by any means, to the combustion temperature of its combustible components, after which oxygen is thrown against it under high pressure. The local combustion heat in the concentrated oxygen current is so enormously high that the neighboring parts will at once become liquefied.

To preheat the material an oxy-hydrogen flame is used to advantage in most cases, while electrical arcs, for instance, can also be used for this purpose. In the latter case it will be possible to pierce cold armor plates of 200 millimeters (8 inches) diameter in about 10 seconds. The current from two accumulator cells that furnish 120 amperes at 2.3 volts will be quite sufficient. The fact that this process renders it possible to remove the iron before the copper from assembled iron and copper plates without any prejudice to the copper, will be found interesting and important for many purposes. This will prove of importance also for blast-furnace operation, it being possible to melt into the extensions of copper or bronze blasting molds or cinder molds without any risk to the copper.

The process will further prove rather valuable whenever dismounting work is to be performed at short notice, the operation being reduced to a few minutes' work, while the cost as compared to the efficiency is quite negligible. It is true that the construction of special types of apparatus is required to enable the process to be carried out safely.

The Academy of Sciences of California has just fitted out and dispatched an expedition to the Galapagos Islands. The expedition has sailed in the schooner yacht "Academy" for Enseñada, Mexico, and after taking out clearance papers there, will visit the following Mexican islands: San Benito, Natividad, Cerros, San Benedicto, and Socorro. After leaving Socorro, the expedition will proceed to Cocos Island, and thence to the Galapagos Archipelago. The chief work of the expedition will be at the Galapagos, where a year will be spent in studying the natural history and collecting specimens for the museum of the Academy of Sciences.

CANALS OF MARS PHOTOGRAPHED.

Of a bird's eye view of a world some forty millions of miles away, all that we can know are contrasts in tone and color, for the real contour of the objects must be forever masked or invisible. In studying the planet Mars these contrasts in color and tone have to some astronomers assumed the form of lines, and, hence, rather fittingly or unfittingly, the name "canals" has been given to them. What are these canals? Some have suggested that they may be tracks drawn by meteorites as they have rushed along the surface; or by minor planets, which became close satellites of Mars in the earlier stages of its formation, and presently in grazing contact run round and round it. Others have supposed that they may be fissures generally following the course of great circles, and in some parts radiating from central points. These, it has been said, might be caused by the cracking of an unsupported crust left behind by a contracting interior; or, on the other hand, by the resistance of the interior to the contraction of a more rapidly cooling crust. It has even been suggested that vapors continuously rising out of such fissures may perform a part in producing the single or double appearance of the various canals. Perhaps most astronomers have been inclined to believe that the so-called canals really do not exist at all; that they are optical illusions, in a word. What is seen is attributed to eye strain. It must be confessed, however, that so many have observed the canals, and so many have drawn them, that their existence can hardly be doubted. Their straightness, their immense length, which in some cases reaches 3,000 or 4,000 miles (nearly equal to the whole diameter of the planet), and their uniform and great breadth, in different instances estimated at 30, 40, or even 60 miles, would seem to augur well for their actual existence.

Perhaps the most assiduous advocate of the existence of these various canals has been Prof. Percival Lowell. To him and to Schiaparelli we are indebted for the most minute observations of their vagaries, and to Lowell likewise for the most picturesque theories of their supposed origin. Lowell sees in them a vast system of artificial irrigation. But their artificial origin can hardly be maintained, when it is considered that they traverse the polar caps, and that their counterparts are to be found in Venus, Mercury, and two of the satellites of Jupiter. That they really do exist, however, has at last been definitely proven by photography.

For a long time it has been the object of the Flagstaff Observatory, of which Prof. Lowell is the head, to photograph the enigmatic canals. Mr. Lampland, of that observatory, has at last succeeded in accomplishing the difficult task. Two obstacles have stood in the way of the attempt. In the first place, fluctuating waves sometimes prevent, sometimes favor the definition of such fine detail as that of the canals. In the second place, most photographic plates are far too slow.

Prof. Lowell determined that the attempt should be made with a bioscope film, in which many successive pictures may be taken, in the hope of securing among them one which would show the canals. A chronophotographic apparatus was therefore devised which, excellent though it was, left much to be desired, chiefly so far as automatic motion was concerned, inasmuch as the camera had to be worked by hand. Still, by diaphragming down the objective to suit the atmospheric currents at the time of observation, the experiment succeeded. Out of the many plates secured, one is here represented, dealing with the region called Syrtis Major. Side by side with it is placed a drawing made by Prof. Lowell shortly before the camera was put on. This serves the double purpose of showing the confirmation by the photograph of the existence of the canals, and at the same time of acting as a chart. The dark triangle with its apex pointing downward is Syrtis Major; the dark area at the top, that is to the south of it, is the Mare Erythraeum. Leading off from the Mare Erythraeum to the right is the narrow dark stretch of the Mare Icarium, separating Aeria on the north from Deucalionis Regio on the south. The bent line from the bottom of the Syrtis, turning sharply to the right as it goes, is the Nilosyrtis, which, continuing westward across the print, becomes the Prontonilus. Making the rest of a rhomboid with the Nilosyrtis two short lines can be descried, one issuing from near the bottom of the Syrtis on the right, the other rising from the Peboas Lucus at the end of the Nilosyrtis, to join it nearly. These are the Astaboras and the Vexillum respectively. Parallel with the second link of the Nilohyrtis and below it shows a long, dark line. This is the Casius. From its left-hand extremity can just be made out a filament, which curves round to the right to enter the Syrtis two-thirds way up on its eastern side. This is the Thoth. From the other end of the Casius proceeds the Pierius. The plate is from an enlargement of one of the original negatives on a scale of 1.8 times.

Inasmuch as such fine detail as the canals, owing to the air-waves, play bo-peep with either observer or camera, it is not to be expected that the more delicate of them should appear in every print. Yet they turn out to come nearer doing so than could have been anticipated. And this because the exposures could not be made instantaneous, but with an aperture of twelve inches, were given on the average eight seconds each. On other plates taken other canals can be made out, notably those bounding Elysium, together with the Helicon, Erebus, and the Hades.

Lowell's Drawing of Martian Canals.

LAMPLAND'S PHOTOGRAPHS OF THE CANALS OF MARS.

The astronomical importance of this feat of photographing the canals can hardly be overestimated. A hot controversy may now be considered definitely settled—a controversy in which most of the eminent astronomers of the world have taken part, either in absolutely denying the existence of Martian canals, or in advocating not only their existence, but also in regarding them as evidences of life on a neighboring world.

THE PYGMIES OF THE CONGO.

As the great searchlight of modern investigation and exploration illumines the dark and unknown portions of the great world which we inhabit, adding day by day to human knowledge and experience, those half-recognized wonders and mysteries, magnified in the eyes of our forbears by tradition and folklore, lose that very characteristic of the mysterious, and each falls into its allotted place in the ranks of the development of the kingdoms, animal, vegetable, and mineral, in the onward march of Nature. And so we often find in the mythology of all races, frequently of the widest divergence, analogous tales and traditions which were formerly believed, either to rest upon a supernatural basis or to have taken birth only within the undeveloped mind of early man, but which, to-day, we know to have arisen from actual physical causes, and which, stripped of the garnishing given them by the centuries, have been explained and traced back to their origins by scientific research.

A GROUP OF CONGO PYGMIES TRAVELING FROM AFRICA TO EUROPE.

In Africa, the Dark Continent, a name for the imaginative to conjure with, have been found many of these explanations of mythological traditions. And it now appears that another, one of the commonest of all, has been deprived of its supernatural possibility as the result of African exploration. The belief in the former existence of fairy-like races of dwarfs, goblins, or elves, is general in all folklore. For years we have been aware of the actual existence of a race of pygmies in the interior of Africa. And now, authorities on the subject have expressed the belief that in this little-known race of black dwarfs, hidden to-day in the fastnesses of the tropical forests of the Congo, but in past centuries probably far more common and widespread, we may have the origin of the dwarfs of tradition. Sir Harry Johnston, the well-known English explorer, made famous by his classic discovery of the okapi and by his researches among the ape-like little black people, is of this opinion.

Roughly speaking, the great forests wherein the pygmies are found cover the entire Congo River basin, while other vast but partially isolated patches seem to indicate that once the entire continent south of the tropic of Cancer may have been one vast forest varying only through climatic conditions. This was, beyond doubt, an important factor in the history of the races of man and animals, a refuge, a barrier, and a deflector in the tremendous incursions and migrations that took place in the prehistoric ages. During the Pliocene invasions, the great herbivores apparently did not penetrate into the forests, but stayed in regions opener and more favorable to their mode of existence, while the great carnivores, which preyed upon the former, naturally did not wander far from the food supply. This left the mighty forest as a refuge for the more timid and defenseless mammals and the anthropoid apes. These were driven from western Asia and Europe by their offshoot, man, and the latter appears to have been the only creature able successfully to contend with the giant ancestors of our present-day gorillas, chimpanzees, and orang-outangs. The anthropoid apes were soon followed by the earliest type of humanity which entered the Dark Continent, and these too, urged on by the pressure of superior tribes, were gradually forced into the great forests.

The human type, in all probability, first emerged from the ape in southeastern Asia, possibly in India. The higher types forced the negro from the continent in an eastward direction, across the intervening islands, as far as Australia, and westward into Africa. Even to-day, ape-like negroes are found in the gloomy forests, who are doubtless direct descendants of these early types of man, who probably closely resembled their simian ancestors. They are found on the eastern border of the Congo woodland and in other portions of the Congo basin, and the attention of scientists was first called to them by Johnston, Grogan, and Sharpe. They are often dirty-yellowish brown in color and covered with a fine down. Their faces are fairly hairy, with great prognathism, and retreating chins, while in general they are unintelligent and timid, having little tribal cohesion and usually living upon the fringes of higher tribes. Among the latter, individual types of the lower order crop out now and then, indicating that the two were, to a certain extent, merged in past ages.

Whence the pygmies came or where they originated is unknown to us. In the hierogiyphic records of the Egyptians and other ancient people are accounts that prove conclusively that the dwarfs existed in Africa at that time. However, from native traditions gathered by Schweinfurth, Junger, and other travelers, it appears that the little people occupied land as far north as the western Nile water-shed, and were driven thence by invasions of larger blacks. To-day they are confined to the Congo forests and to such portions of these as extend toward the Nile watershed and into Cameroon and French Gaboon. There seems to be some connection between the pygmies and the bushmen of South Africa, and if this is true, it gives color to the theory of the former wider occupancy of the continent by the dwarfs. Traces of pygmies have been found in Europe, and while there is no absolute proof of a prehistoric, universal, dwarf people, there is some ground for belief in the truth of this, and the acceptance of this theory furnishes us with an explanation for the general occurrence of the mythological dwarfs in human folklore.

The personal appearance, characteristics, and traits of the Congo pygmies seem to give support to this belief. Small, ape-like, elfish creatures, furtive and mischievous, they closely parallel the brownies and goblins of our fairy tales. They live in the dense tangled forests in absolute savagery, and while they exhibit many ape-like features in their bodies, they

possess a certain alertness, which appears to make them more intelligent than other negroes. Such is their woodcraft, that they seem to have the power to appear and disappear like the elves themselves. They are even said at times to steal the children of the bigger negroes, leaving in place of these their own weazened offspring. Some truth is lent this by the appearance, among the little people, of blacks of normal size and feature, though these may be fugitives from the tribes of other negroes. They are shy to a degree, and it is almost impossible for a stranger to approach them. This can only be accomplished through the mediation of a member of some tribe of larger blacks, with whom the little people have entered into friendly relations. Once their confidence has been obtained, they may be studied with less difficulty, though even then it is hard to get a closer insight into their lives and pursuits.

The existence of the pygmies is of the rudest; they do not practise agriculture, and keep no domestic animals. They live by means of hunting and snaring, eking this out by means of thieving from the big negroes, on the outskirts of whose tribes they usually establish their little colonies, though they are as unstable as water, and range far and wide through the forests. They have seemingly become acquainted with metal only through contact with superior beings, and their weapons were formerly of wood or stone only. They live in little conical huts about four feet high and four feet in diameter, constructed by thrusting withes in the ground, tying them together at the top, and thatching with leaves. Each man usually has but one wife, the couples housing together in a single hut, but as soon as a child leaves the mother's breast a separate hut is constructed for it, and as we can imagine, some of these are absurdly tiny. The women are said to be affectionate and make dutiful wives, sometimes marrying into the tribes of the larger negroes.

The dwarfs have no separate language of their own, but speak, roughly, the dialects of the neighboring tribes of large blacks. Their intonation is musical, the pronunciation sharp and staccato. They learn other languages with ease, and are admirable mimics. They are fond of dancing and singing, their songs being frequently decidedly musical. Their dances are extremely grotesque and ludicrous, and are usually executed to the sound of their one musical instrument, a drum formed from a section of a hollow tree, covered with hide. Their only æsthetic ornament consists in having two holes pierced through the upper lip, into which they insert flowers, teeth, or porcupine quills. While in the forests, they are usually absolutely unclothed, but they adopt sufficient covering for decency when they come into contact with others.

The pygmies appear to be divisible into two types, one with reddish or yellowish-brown skin and a tendency to red in the hair, and the other black-skinned with black head-hair. The original type may have been the red one, and, mingling with the first negro invaders, have produced the black dwarfs. The black type is slightly larger, the tallest individual remarked by Sir Harry Johnston being five feet tall. According to the measurements of Johnston or his assistants, the average height of the men is about four feet seven inches, while that of the women is four feet two inches. The face is prognathous, the upper lip long and not everted as much as in other types of negro, the chin weak and receding. The nose is broad, the wings large and prominent, the bridge very low. The neck is short, the head sunk between the shoulders, while the legs are short also, the feet large and turned in, the great toes having a tendency to separate from the others. The pygmies are fairly hairy, and sometimes have beards of considerable length. The body hair is of two kinds, one a survival of the yellowish-brown fœtus hair common to all men, and the other a fairly thick growth on the chest and stomach.

Many attempts have been made to bring members of these dwarf tribes to civilized countries, but these have almost uniformly failed, because of the reluctance of the little blacks to leave their native forests. Within recent months, however, a number of the pygmies have been brought to London, where they aroused great interest. The accompanying engraving shows a group of the dwarfs on shipboard while traveling from Africa to Europe.

August Number of American Homes and Gardens.

The August number of American Homes and Gardens—the second issue of the new series of the Scientific American Building Monthly—fulfills and improves on the promises made in the July number. The splendid house built on the Wissahickon near Philadelphia for the late Mr. C. W. Bergner is illustrated and described by Barr Ferree, together with half a dozen other houses, most of which are abundantly illustrated with plans and interior views. George E. Walsh contributes an interesting paper on "Angoras for Pleasure and Profit"; Enos Brown reviews some of the latest and most important work of Mr. Burbank in a paper entitled "Luther Burbank and Plant Breeding"; Walter A. Dyer writes suggestively on "The Nursery in America"; Joy Wheeler Dow continues his series on "Principles of Home Decoration"; and A. Russell Bond has a strong article on "How to Make a Camp in the Woods." Other articles comprise a discussion of the relationship between the arts and the house, and the first part of a valuable paper on "The Architect and His Charges." The Departments include "The Garden," "The Household," "Civic Betterment," "Science for the Home," and "The Observer" makes his first appearance with some shrewd and entertaining notes on "Suburban Development." "New Books," "Fifty Suggestions for the House," an article on "Cyanide Fumigation," and other timely papers make up a strong and valuable number of this fine magazine.

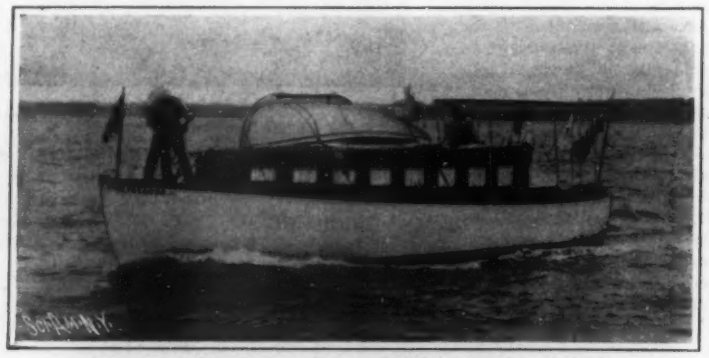
Many readers state that American Homes and Gardens is the handsomest of the monthly magazines. The interest of the illustrations and the fine printing of the August number amply justify this statement.

AMERICA'S FIRST LONG-DISTANCE MOTOR-BOAT RACE.

The first long-distance race for power-driven boats which has been held in this country took place on July 22, 23, and 24, over a course some 325 miles in length, extending from College Point, N. Y., through Long Island, Block Island, Vineyard, and Nantucket Sounds, and around Cape Cod to Marblehead, Mass. The race was for boats under 40 feet in length, each of which was required to carry a crew of four men and a full equipment, consisting of rope, oars, bucket, compass, charts, lead line, cushions, blankets, cooking outfit, water, and provisions for a five days' cruise, and lastly, a life preserver for each member of the crew. One member of the crew of each boat could be a paid hand, but this must not be the pilot. The race was run under the auspices of the Knickerbocker Yacht Club for a cup offered by The Rudder. The boats were entered under the rules of the American Power Boat Association, and various time allowances were given. Twelve boats crossed the starting line in 1½ minutes at noon on Saturday, the 22d ultimo. The largest of these, the "Blink" (which was 40 feet long over all and 36 feet on the waterline, with a beam of 8 feet and a draft of 2½ feet) was the scratch boat, while the "General Bumps" (having a length over all of 28 feet, a waterline length of 26½ feet, a beam of 6 feet 8 inches, and a draft of 1 foot) was the smallest, and was given a time allowance of 14 hours, 36 minutes, 32 seconds. This boat had an 8-horse-power, twin-cylinder Grant-Ferris motor, while the "Blink" had a 30-horse-power, four-cylinder Buffalo engine. Five of the remaining boats were about 39 feet in length, and the remaining five about 32 feet. The highest-powered boat in the fleet was the "May," which was a very handsome 38-foot cruiser fitted with a 50-horse-power, four-cylinder New York Kerosene Oil Engine Company's motor employing as fuel ordinary kerosene sprayed into the cylinder and ignited by an electric spark. The "Talisman," entered and run by its owner, William Saville, of Boston, represented the simplest type of cruiser, being fitted with an 8-horse-power, single-cylinder, Murray & Tregotha engine having an 8-inch bore and 10-inch stroke and consuming about 1½ gallons of gasoline per hour. This boat, which turned out to be the winner, was 32 feet 8 inches long over all, 29¾ feet on the waterline, 8 feet 7½ inches beam, and 2 feet 1 inch draft. She had the greatest time allowance of any in the race, this being 16 hours, 44 minutes, and 19 seconds.

The boats had good weather during the first ten hours, but notwithstanding this, several of them de

"Talisman," the Winner. Average 6⅛ Knots, or 7⅛ Miles an Hour.



"Glissando," Which Won the Second Prize on Time Allowance.

Start of the Race at College Point. The Course Was Some 325 Miles in Length, Extending from New York City to Marblehead, Mass.

THE FIRST LONG-DISTANCE RACE FOR 40-FOOT MOTOR BOATS OF THE CRUISING TYPE TO BE HELD IN AMERICAN WATERS.

veloped troubles that delayed or stopped them. The "Igniter," a 32-footer equipped with a 15-horse-power, four-cylinder Buffalo engine, developed a broken thrust bearing (which was of the ball-bearing type) before she had gone 40 miles. By putting in at Norwalk, the crew got the bearing repaired and afterward ran as far as Plum Island, when cracks in the thrust collars developed again, and they were obliged to give up the race. The "May" also dropped out of the race at New Haven, on account of trouble with her clutch.

During Saturday night and Sunday the boats encountered a severe easterly storm, which caused several of them to put into the nearest harbor and wait for the weather to moderate. Among the boats that withdrew during this part of the race was the "Em Bee." The first boat to appear at Cottage City, Mass., was the "Blink," which arrived at 9:30 Sunday morning. The "General Bumps" arrived at 1:40 P. M., and left a half hour later. As this boat was passing out of the harbor "Talisman" came in, and reported sighting several boats anchored along the Rhode Island shore. As no more of the leaders arrived before dark, it was apparent that the average time made by the winner would be slow. The "Aquila" was obliged to put into Vineyard Haven on Sunday afternoon because of weak batteries. These were replaced, and she left at 5:50 P. M.

The first boat to appear at the finishing point opposite Marblehead was the "Talisman," which, it will be remembered, had the biggest handicap and the lowest rating of any of the craft. She crossed the finishing line at 9:24:56 A. M., having made the run of 280 nautical (322 statute) miles in 45 hours, 24 minutes, and 56 seconds. During all this time the engine had been kept running without a single stop; and, although the boat stopped a few minutes at Cottage City to report, it had immediately resumed the race, and fought its way against a head wind and heavy sea around Cape Cod and northwest to Marblehead. Not until after passing Highland Light at 2:10 A. M. Monday morning did the wind shift from dead ahead, at which point it had been for more than twenty-six hours. Although this made the course somewhat easier, the weather was still very rough, and the wind, striking the boat asiant, drove the spray in cutting sheets over its occupants. While crossing Massachusetts Bay a heavy fog was passed through. Despite this long journey through the various sounds along the coast and around Cape Cod in the Atlantic Ocean during a heavy gale, the staunch little "Talisman" showed but little the effect of the tremendous tossing she had received during the greater part of her trip. The putty was squeezed out of her forward seams, but she did not leak, and the only damage she sustained was to her steering gear. A rope broke, and a temporary iron tiller was used while repairs were being made. That the little boat could maintain an average speed of 6½ knots (7.49 miles per hour) under the severe weather conditions encountered is truly remarkable, and is a thorough demonstration of the great seaworthiness and reliability of the American launch or motor boat, as it is nowadays termed.

The second boat to finish, the "Blink," reached Marblehead at 5:27:10 Monday afternoon, or 8 hours, 2 minutes, and 14 seconds after the "Talisman," which, if her time allowance is considered, beat the larger boat by 24 hours, 46 minutes, and 33 seconds. Rough weather on the shoals and trouble with her muffler, which became disconnected in a heavy sea, caused the "Blink" to put in at Hyannis, where she lay several hours during Sunday night, and was passed in the meantime by the "Talisman." The third and fourth boats to finish were the "Aquila" and the "Glissando," which arrived within four seconds of each other, the former at 7:30:08. The latter boat, because of her time allowance of 10:37:56, won second place from the "Blink" by 8 hours, 34 minutes, and 58 seconds, and was awarded the second prize.

The fifth and last boat to finish was the "Woodpile," which crossed the line at 2:48 A. M. July 25. This was one of the two boats equipped with a two-cylinder, two-cycle motor, all of the others having motors of the four-cycle type. Although less than half of the contestants finished, the race may be considered a success, as most of the boats which failed did so on account of minor troubles, and not because of unseaworthiness or badly-operating motors. While most of the boats were new this year, and specially built for the occasion, the winner is a year old, and was built for her owner to be used as a comfortable family cruising boat. The great seaworthiness of this type of boat, and the entire practicability of its use in the roughest weather, stamps it as a type far superior for comfort and for every-day use to the high-powered freaks, such as tried to cross the Mediterranean last spring with such disastrous results. That a boat of this kind can live in the open sea during a storm, shows the entire practicability of equipping our life-saving stations with motor life-saving boats, and it is to be hoped that the government will soon take some steps in this direction.

A new type of coupling for railroad cars has been devised by Mr. Edward Watson, of Glasgow, and some interesting demonstrations were recently carried out therewith. The coupling comprises two similar steel castings, one fixed to each car and projecting from the center of the ends of the wagon, and limited as regards side and end motion due to buffing shocks by springs in the usual way. Each coupling has two catches with taper faces. When the cars meet, the pressure between the opposing faces causes a partial rotation of the coupling. This allows the catches to engage with each other, and the vehicles are locked together. The coupling heads are absolutely devoid of pivoted catches, springs, and other such devices. The heads may be unlocked by raising a lever on each side of the train, and return automatically to their working position as the wagons separate, if required.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

SAFETY SIGNAL SYSTEM. — F. V. KING, Winslow, Ariz. Ter. Train and engine men sometimes forget that they have to meet and pass another train at a point on the run and run past and collide with the other train. The object of the inventor is to provide mechanism whereby when the predetermined point has been reached a signal will be operated in the cab or car, so that the conductor's or engineer's attention will be called to the order received from the train-dispatcher at some station back on the road, whereby he will again read his order and be prevented from passing such predetermined point without carrying out such order.

Of Interest to Farmers.

FOLDING COOP.—B. YOAKUM and P. C. MCKEE, Houston, Texas. The invention relates to folding coops used for the transportation of poultry, such as live fowls, from one point to another by boat or rail, and has for its object to provide novel details of construction for a folding coop which render it very substantial either when erected for service or when folded into a compact package and enable the production of the coop at a moderate cost. The invention affords convenient means for supplying food and water and to keep these clean in transit when a number of these coops with poultry are piled in tiers in cars or vessels.

HARVESTER. — J. W. BURTLESS and J. W. LITTLE, McCook, Neb. This machine operates advantageously in cutting and loosening the earth and turning away a portion at each side of the row by the disks, which relieves the scoop and prepares the beet to be readily freed from the soil; in maintaining position of the beet until grasped by the conveyers, preventing its presentation to the cutters in a wrong position; in the automatic adjustment of cutters by the gage, which compels a fixed depth of cut, without regard to position of beet, and in ready adjustment of all operating parts and their adaptability to varying conditions.

HAY-RETAINING DEVICE FOR STACKERS.—J. O. MCCREERY, Fort Morgan, Col. This device has a fixed position relative to the carrier-teeth of the stacker, the rake-teeth being adapted to pass over the device when depositing hay on the carrier-teeth, and the device has tension-controlled fingers automatically depressed as the rake-teeth pass over the carrier-teeth to deliver their load to the latter and which fingers automatically rise at the back of the load of hay prior to the withdrawal of the rake-teeth, so that when the latter are withdrawn from the carrier-teeth no portion of the load is withdrawn.

Of General Interest.

TROUSERS-RETAINER.—S. REITER, Jersey City, N. J. One feature of the invention is to provide a belt or elastic strap which follows the exterior of the trousers at the waistband, extending along the back of the waistband, being attached at its extremities to the forward suspender-buttons, so that while the trousers are held up by the device in a comfortable manner no severe pressure is brought to bear upon the abdomen.

RAZOR.—C. L. GIRARD, Little Valley, N. Y. This implement belongs to that class known as "safety razors," and the purpose of the improvement is to provide a razor of the usual form or type in which instead of the blade being an integral portion of the shank a shell is directly connected with the shank, having the customary cross-sectional and longitudinal shape of an ordinary razor-blade, while the blade is made very thin, with straight side faces, and is mounted for movement in said shell to and from its back and open front edge.

SHIPPING-PACKAGE. — A. FONTS, New York, N. Y. This improved shipping-package is more especially designed for safely shipping fresh tomatoes and like perishable products from a warm climate to a cold one and for distributing the products in the cold climate to retailers during the winter season, to prevent freezing of the products while in transportation, or distribution.

PNEUMATIC PILLOW.—L. F. DOELLINGER, Des Moines, Iowa. In this instance the invention refers to pneumatic pillows and the like, Mr. Doellinger's more particular object being to provide means for readily inflating it. These means very conveniently and quickly insure the operation of inflating, deflating and folding. The pump is a portable affair forming practically a part of the pillow and is preferably left in position while in use. When the pillow is in use the pump is concealed.

COPY-HOLDER. — J. COOK, Oelwein, Iowa. This holder is of that class used by the operators of type-writing machines for holding notes or copy which is being transcribed. The object of the invention is to produce a device of simple construction which is especially adapted for holding copy of all kinds in a simple manner. A feature is the extensibility of the device and the simplicity of its construction to facilitate its easy operation.

FRAMELESS AWNING.—S. C. CROWE, Boston, Mass. The chief objects of the invention are to do away with the frames that are ordinarily used and to provide means for efficiently and effectively operating the awning-cover to open and close it. These objects are accomplished by substituting movable bars for the frame and employing a system of flexible connections for manipulating the bars and cover.

CHEESE-CUTTER.—B. BLOOD, Cœur d'Alene, Idaho. In the present patent the invention is an improvement in cheese cutters, and relates particularly to the devices in connection with the knife whereby to indicate accurately the amount of cheese to be cut from any bulk to secure a slice of any desired weight.

COUNTER-GUARD.—J. S. AUERBACH, New York, N. Y. In this case the improvement has reference to counter-guards, the inventor's more particular object being to provide a type of guard which can be used for supporting transparent plates over a counter, so as to protect candies or other merchandise and to enable the same to be displayed to advantage.

ARTIFICIAL UPPER DENTURE. — L. L. WHITE, Portland, Ore. The invention relates to dentistry, and its object is to provide certain new and useful improvements in artificial dentures whereby the plate is caused to cleave to the roof of the mouth by atmospheric pressure. The arrangement can be cheaply manufactured, and the dentist can conveniently place the denture securely in position.

TENT STRUCTURE.—J. E. WALSH, New York, N. Y. This claim is on improvements in tent structures, the object of the inventor being to provide a tent having a framing the several members of which may be readily put together to form a strong and durable structure and that may be separated and packed in a comparatively small space convenient for transportation or storage. It is particularly designed for military camps, fields, hospitals, etc.

Heating and Lighting.

VENTILATING-HEATER.—C. B. HOLDING, Toledo, Ohio. This improvement refers to a heating device which is arranged to act as a ventilator and which is provided with means for causing circulation of the heated air. The objects are to provide for the above functions, and especially to obtain a stove or other heating device which will permit the passage of air directly through the fire, but out of contact with it, in order to quickly and efficiently heat it.

Household Utilities.

SHUTTER-FASTENER. — W. A. JORDAN, New Orleans, La. The invention pertains to improvements in fasteners which are used on the inside of ordinary hinged shutters and which engage with lugs or catches on the window frame. The object is to provide a fastener which cannot be released from the outside when the shutters are closed and which will be certain in its action and which can be securely locked in operative position.

Machines and Mechanical Devices.

REELING-MACHINE FOR PAPER OR OTHER FABRICS. — W. H. WALDRON, New Brunswick, N. J. The object of the present invention is to provide a machine arranged to insure automatic reeling or winding up of paper or other fabric, to allow convenient adjustment of the winding-roll, and to permit bringing the paper under proper tension. The invention relates to machines, such as shown and described in the Letters Patent of the United States formerly granted to Mr. Waldron.

FIRE APPARATUS.—S. A. A. STENBERG, San Francisco, Cal. The object of this invention which relates to stationary fire-systems, is to provide a fire apparatus designed for use on fire-hydrants in streets and other places and arranged to permit firemen, policemen, watchmen, and other authorized persons to make immediate use of the apparatus for extinguishing fires in the immediate neighborhood in which the hydrant is located.

GAS-GENERATOR. — J. J. NIX, Los Angeles, Cal. An important feature of the invention lies in the provision of two combustion and expansion chambers separated by a shallow checker-work of large area, thus allowing perfect expansion of the gas and a consequent gain in volume and bringing about a thorough association between the gas and checker-work, so as eventually to fix the gas. It relates to apparatus for generating gas, particularly from hydrocarbon oil atomized by air and steam.

MACHINE FOR MAKING PAPER ARTICLES.—F. J. MOTT, New York, N. Y. The invention resides in a certain novel machine by which seamless paper articles may be produced, the machine being of that form having a vat and means for automatically submerging foraminous shapes therein and withdrawing them therefrom and exerting through the shapes a fluid movement during the submergence, thus causing the pulp to adhere to the shapes, so that after withdrawal from the vat the pulp may be allowed to harden or set on the shapes to form the finished articles.

OIL-PRESS.—D. J. HEIDERICH, Boyce, La. The leading feature of the invention resides in the arrangement of (preferably two) rotary turrets, each bearing a number of press-cylinders. The inventor employs means by which he greatly increases the capacity of the press and by a novel manner of interarranging the elements is able to dispense with a large percentage of the labor skilled and unskilled heretofore employed in this class of machinery. It relates to a press adapted particularly for producing oil from cotton seed and other oil-producing material.

SAW-FILING MACHINE. — C. H. BLACK, New York, N. Y. In this patent the invention has reference to a machine for filing saws; and by this means a saw may be placed in the machine and the machine adjusted so that by driving the machine the saw will be accurately and uniformly filed throughout its length.

RATCHET-WHEEL MECHANISM. — A. BENOIT, J. GUERNIFFEY, J. NICAULT, and E. DANGER, 7 Rue Deparcieux, Paris, France. The object of this invention is to provide a mechanism which will allow of the ratchet-wheel being rapidly revolved by a step-by-step rotation, while being prevented each time from turning farther than the distance at which the pawl has moved forward whatever may be the speed and momentum of the wheel and the elements which revolve with the same.

LAWN-MOWER ATTACHMENT. — J. W. BONSALL, Glenville, Ohio. Mr. Bonsall's invention has reference to an improvement in lawn-mowers, his object in this instance being the reduction of the number of parts and the prevention of any grass being carried around by the rotating knives and insuring the cutting of all grass within the path of the mower.

Prime Movers and Their Accessories.

ROTARY ENGINE. — H. M. LOFTON, Atlanta, Ga. This invention relates particularly to that class of engines in which a revolving piston, provided with blades which may be projected from and drawn into its rim, operates within a casing to which steam is admitted and exhausted; and has for an object to provide means whereby to secure an efficient operation of the steam upon the blades and to relieve any tendency of steam to press the blades tightly against the walls of their guide-grooves in such manner as to impede free operation of the blades in the piston.

ROTARY ENGINE.—J. R. LEWIS, Jersey City, N. J. The invention relates to engines and more particularly to those of the rotary type. Its principal objects are to provide a simple and efficient engine. By the means employed both the impact and expansion force of the steam are utilized. If the apparatus is to be used as an internal-combustion engine, the supply may be to the casing-section, the exhaust of which is delivered to one of the two separate sections. In this manner not only is the impact of the exhaust applied to the rotating of the shaft, but a muffling effect is secured in its passage between the blades with comparatively little back pressure.

OIL-BURNER.—W. S. JENKINS, Cleburne, Texas. This improvement pertains to an apparatus for burning heavy oils with the aid of an atomizing-jet. It is particularly adapted to locomotive-work; but it is useful in other connections—for example, with stationary and marine boilers. A special feature lies in an arrangement causing the oil to flow steadily from the burner in common with the atomizing-jet of steam or other fluid, thus producing a regular flame and thorough combustion.

ROTARY VALVE.—J. CRUIKSHANK, Yorktown, Va. In the present patent, Mr. Cruikshank's invention is an improvement in the valve action of steam-engines, and is intended to relieve the valve-seat of boiler-pressure and to keep the balance without readjustment, without regard to what pressure there may be in the boiler. This note will be followed later by a cut and a fuller explanation of this important invention.

Railways and Their Accessories.

MAIL-BAG-DELIVERY DEVICE.—P. J. A. SCHNOOR, Holstein, Iowa. Mr. Schnoor employs a specially-constructed derrick at each of the railway-stations or other places at which the mail-bags are to be delivered and taken up by the devices on the car, and within the car employs a specially-constructed swinging crane, combined with retaining devices therefor, as well as operating devices and specially-constructed brake devices for preventing motion of the car from causing the mail-bag to be carried too violently within the car as the crane is caused to be swung in an inward direction.

BRAKE.—C. E. F. BURNLEY, Eckman, West Va. This brake is more particularly adapted for use upon such vehicles as mine-cars. When brakes are mounted upon hangers supported upon fixed pivots, they must be constructed with accuracy to secure equal pressure upon front and rear wheels, and even this will continue only so long as wear on shoes is identical, a condition not attained in practice. Therefore one pair of shoes wears more than the other and power applied is expended upon the least-worn pair and the hangers, with companion shoes having little or no friction upon the wheels. This invention allows the shoes to bear upon the wheels with equal force, this continuing until all the shoes are worn out.

Pertaining to Recreation.

SWING.—T. H. BARGER, Peekskill, N. Y. Mr. Barger's invention pertains to swings, the main objects being to secure great flexibility and to provide for the operation and expenditure of comparatively little power without introducing any complications or any features likely to get readily out of order.

Pertaining to Vehicles.

LOG-CART.—R. J. WILLIAMS, Natalbany, La. In operation the tongue of this device is made slidable by removing a pin, and the sets of hooks are attached to the logs to be carried. Horses or other moving power is attached to the tongue end, and by this means a chain will draw a lever forward until the hook engages a catch. Logs are thus raised by reason of chains being wound on a drum. The tongue is then slid back, and the pin is again placed in its opening and logs are ready for transportation. To unload, lift the handle of the catch, to disengage the hook, and the logs' weight causes them to drop upon the ground on skids. Hooks disengage themselves, and the cart is ready for another load.

VEHICLE.—T. WILSON, Lewistown, Mont. The invention relates to vehicles, and particularly to sleighs. The principal object is to provide an automobile vehicle of this character which will operate satisfactorily under varying conditions of surface over which propelled. Although in this case the power-shaft is rotated by means of an explosive-engine, any convenient motor may be employed or if the vehicle be sufficiently light hand-operated mechanism may be used to effect the driving of the shaft.

Designs.

DESIGN FOR A PENDANT.—G. FOX, Cincinnati, Ohio. This design is for a watch-chain pendant, society pin, or badge. It includes two elks facing each other, rampant, their horns being connected by a ring, and the hind legs of the animals being attached to and suspending ornamental scrolls surrounding a disk or plate bearing a representation of a mallet and a rolled chart.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 7104.—For manufacturers of picture mouldings.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 7105.—For manufacturers of blue flame (paraffin) stoves.

For bridge erecting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 7106.—For manufacturers of red cedar bark.

2d-hand machinery. Walsh's Sons & Co., Newark, N.J.

Inquiry No. 7107.—Wanted, small planing mill with all equipments.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 7108.—For manufacturers of alcohol engines.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Ball St., Chagrin Falls, O.

Inquiry No. 7109.—For manufacturers of nut-cracking machinery.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 7110.—Wanted, address of the Mitchell models of the Westinghouse air brake.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 7111.—For manufacturers of advertising novelties.

Marketors of meritorious inventions and specialties throughout the world. Tatem Mfg. Co., Buffalo, N. Y.

Inquiry No. 7112.—For manufacturers or users of automatic electric switching devices for use on street railways.

I sell patents. To buy them on anything, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 7113.—For manufacturers of small, flat flexible chains.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of E. 138th Street, New York.

Inquiry No. 7114.—For manufacturers of high-grade toilet mirrors.

WANTED.—Manufacturers of the Solid Back Scrub Brush, and other brushes. Handy Article Co., 117 S. Michigan Street, South Bend, Ind.

Inquiry No. 7115.—For manufacturers of weight motors or blowers, to be used in connection with gasoline light system.

Gut strings for Lawn Tennis, Musical Instruments, and other purposes made by P. F. Turner, 48th Street and Packers Avenue, Chicago, Ill.

Inquiry No. 7116.—For manufacturers of air pumps to be run by water for gasoline light system.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, wood fiber machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 7117.—For firms who sell all kinds of household goods, hardware, etc., nothing to cost over 10 cents each.

Absolute privacy for inventors and experimenting. A well-equipped private laboratory can be rented on moderate terms from the Electrical Testing Laboratories, 548 East 80th St., New York. Write to-day.

Inquiry No. 7118.—For manufacturers of wire goods such as paper fasteners, small coil springs for holding display cards, etc.

WANTED.—To buy ideas or patents for new articles to manufacture as a side line. Will consider all propositions, but prefer articles commonly used by the populace. Briefly give full particulars. F. Raniville Co., Grand Rapids, Mich.

Inquiry No. 7119.—For manufacturers of cellulose from cornstalks.

QUANTITY CLERK WANTED.—In the office of a large ornamental iron and bronze manufacturing company. A man understanding plans. Opportunity to develop from drafting office to quantity and estimating clerk. Address Clerk, P. O. Box 773, New York.

Inquiry No. 7120.—For manufacturers of beads out of soft stone.

A GOOD LOVE STORY.

"A Paper Proposal" is the title of a clever piece of fiction contained in "Mountain and Lake Resorts," a book just issued by the LACKAWANNA RAILROAD in which some of the most delightful summer resorts in the east are illustrated and described. The story is well worth reading, and the other information may help you in selecting your vacation place.

The book will be mailed on receipt of ten cents in stamps addressed to T. W. LEE, General Passenger Agent, New York City.

Inquiry No. 7121.—For manufacturers of condensers for telephone or wireless telegraph.

Young man, practical engineer, large acquaintance, desires to represent manufacturer on Pacific coast on commission basis; can furnish best of references as to industry, character and ability. Address W. Brown Smith, 639-642 Laugh'in Building, Los Angeles, Cal.

Inquiry No. 7122.—For manufacturers of glass tubing having 1.16 inch inside diameter, for making wireless telegraph coherers.

Inquiry No. 7123.—For parties who can furnish raw hide.

Inquiry No. 7124.—For manufacturers of wire musical instrument strings.

Inquiry No. 7125.—For manufacturers of advertising novelties.

Inquiry No. 7126.—For manufacturers of capsules of carbon dioxide gas; also siphon for charging water.

Inquiry No. 7127.—For parties selling sheet aluminum and a soldering flux for soldering aluminum.

Inquiry No. 7128.—For manufacturers of machinery for making bran into fine flour.

Inquiry No. 7129.—For manufacturers of brass band instruments.

Inquiry No. 7130.—For manufacturers of springs wound by a key and run for five or ten minutes.

Inquiry No. 7131.—For parties who print colored pictures on paper in one continuous piece of about 6 inches wide and 12 feet long.

Inquiry No. 7132.—For manufacturers of telescoping steel flag poles.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9717) P. H. C. asks: 1. I ask you to explain in your column of Notes and Queries why a small battery motor will run on a 110-volt alternating current when a 50 candle-power lamp is put in series. If the 50 candle-power lamp is removed and a 16 candle-power put in its place, the motor will not start. A. A 16-candle lamp does not carry current enough to run your motor; a 50-candle lamp does. 2. How long a spark ought an induction coil to give which is 8 inches long, 7½ inches in diameter, the core being 1 inch in diameter; the primary coil consisting of two layers of No. 16 copper wire and the secondary coil containing 4 pounds of No. 36 copper wire? A. You may be able to get a spark 3 inches long from your coil, but its proportions are not of the best. The primary winding is of too small a wire. No. 12 would have been right. The coil is too short. It should have been 12 or 14 inches. This would have made the outside diameter less, and brought the secondary nearer the primary and into a stronger magnetic field. The coil might then have given a spark of four inches. See our SUPPLEMENT No. 1527 for plans for a 4-inch coil; price ten cents. 3. Having five known parallel forces applied at known points to a stick, what is meant by taking one of those points as the center of moments? A. When a point is taken as the center of moments, a force acting at that point does not assist in any way to rotate the stick. It simply produces pressure on the point. 4. What is meant by moments of forces? A. The moment of a force is the value of that force in producing rotation of the bar or wheel to which it is applied. The value of any force in moment is equal to the product of the force multiplied by the acting distance of the force. See textbook of physics for full explanation of moments and forces.

(9718) G. W. asks: 1. In a sal-ammoniac battery the zinc was crystallized. Now I suppose that the zinc ions were deposited on the carbon. A. If too strong a solution of sal-ammoniac is used in the Le Clanche cell, the result is the formation of crystals upon the zinc which cut down the current from the cell. The solution should not be stronger than 3 ounces of sal-ammoniac to a pint of water. We do not think the zinc ions had given up their job and returned to the carbon in your case. Since the solution was too strong, there were not so many ions as there should have been for the production of current. 2. I have a small spark coil which we made ourselves, and a while ago tried to work it with four cells of dry battery, and the amperage in four cells was the same as in one. Why was this? A. The discovery that four cells in series gave no more current than one cell has been made as an original discovery by a great many people who had not learned the relation of the resistance of the circuit to the proper arrangement of the battery. When the resistance of the circuit is low (the external resistance, as it is called) put the cells in multiple. The addition of cells in series does not increase the amperes delivered to the line proportionally, and energy is wasted. On the other hand, when the external resistance is high, put the battery in series. You will find this demonstrated in textbooks of electricity. See Swoope's "Elementary Lessons," price $2 by mail.

(9719) F. J. B. asks: We have a small ground switchboard with series jacks, from which it seems as if we could hear talk when lines are busy, but though they sometimes talk quite loud, nothing can be distinguished. A. Grounded lines are almost inevitably subject to the annoyance of cross talk. It is due to the fact that different wires lie nearly parallel to each other, over some portion of their course; perhaps in coming into or in going out of the central. The only certain remedy for this is a metallic circuit. Then the wires of each circuit are carried on the poles in such a way that they are twisted around each other quite often.

(9720) E. De V. asks: Will you please tell me what kind of steel makes the best bar magnets? Also, I would like to know the relative strength of bar and electro-magnets. A. For permanent magnets some prefer Jessop's steel, some Stubs' steel, some manganese steel, and some tungsten steel. Probably any good high-grade steel will answer very well for the purpose, with little to choose. This is generally the case when there are so many opinions on a matter. There is no "relative strength" of permanent magnets. A good permanent magnet may lift five times its own weight. An electro-magnet will lift much more than this.

(9721) J. J. G. asks: Does an object which is viewed through the telescope of an engineer's transit appear to be larger than when seen with the naked eye? Although this may seem to you to be a foolish question, I find that several of my acquaintances, two of whom are graduate civil engineers, claim that while the image is clearer, it is no larger. By looking through the telescope with one eye and past it with the other, I am able to see both object and image at the same time, and thus seen the superficial areas appear to be about as 1 to 16. My friends claim that this is due to my eyes, but I do not think so. A. An engineer's transit usually is provided with a telescope which will magnify from 3 to 6 diameters, or from 9 to 16 times. If it did not magnify at all, an object seen through it would not be seen any more distinctly than with the naked eye. A simple way to determine the magnifying power of a glass is to look at bricks at some distance with one eye through the telescope and with the other eye directly. Find how many bricks seen with the naked eye are covered by one brick seen through the telescope. This is the number of diameters the telescope magnifies.

(9722) E. G. S. asks: Will you kindly give an explanation of the following through the columns of your paper? If a one-cent piece be centered over the end of a spool such as cotton thread comes on, and barely supported by pins, a current of air blown through the hole in the spool, instead of forcing the coin away actually produces a kind of suction and holds the coin tighter than ever, so that the spool may be held in a position where the coin will fall off as soon as the current of air stops, while something seems to hold the coin on while the current of air is passing. A. There are many variations of the spool and coin experiment which you ask about. Some of these are given in Hopkins's "Experimental Science," which we send for $5. The most practical one is the ball nozzle of fire engine hose to disperse the water as it issues from the nozzle in a fine spray, the ball in the nozzle sticking tighter as the pressure of the water increases. The explanation is simple. The air is forced to spread out under the coin as it issues from the hole in the spool, and as it spreads the pressure of the air is reduced. The swifter the stream of air the more rapid the spreading of the air, and the more the consequent reduction of the pressure of the air under the coin. So the air under the coin has less pressure than the outer air, and this excess of pressure of the outer air it is which pushes the coin against the end of the spool.

(9723) J. W. M. says: Does the shadow of a cloud move over the earth's surface faster than the cloud, the cloud moving in an easterly direction? If so, is the difference susceptible of measurement? Would the time of day affect the answer to the question in any way? Or the direction of the cloud's motion? A. The shadow of a cloud does not move perceptibly faster than the cloud itself moves. Clouds vary in altitude above the earth's surface. Aeronauts at the highest altitudes attained have still seen cirrus clouds above them. The ordinary heavy cumulus clouds, however, are not at any high altitudes; probably five miles would be a maximum for them. So the distance of the cloud from the sun is almost the same as the distance of the earth's surface from the sun, and the shadow of the cloud, cast by the sun, will move with the same velocity as the cloud and in the same direction. Nor can the curvature of the earth, that is, the time of day, affect the relative motion very much.

(9724) H. N. asks: 1. G. F. in Query 9677 says: Is there any sound when there is no ear to hear it? I read in a book of the roaring gale on the vast ocean where no ship had ever sailed. The sea gulls were supposed to hear it. Now, can there be a howling gale without such obstructions as a ship's rigging, etc., to cause the sound? A. The explanation of what you write about sound is found in the dictionary in the meanings of the word. There are two. One is the sensation in the mind, as when you say "I hear a sound"; the other the mechanical cause of the sensation, as when you say a sound is produced by the vibration of some heavy body. In the first sense there is no sound where there is no ear to receive it. 2. What reduction is made in the lifting power of an ordinary hand well pump at different altitudes? A claims that at this elevation, 3,000 feet above sea level, 25 per cent of height should be deducted, i. e., the pump won't lift water 33 feet, but only 75 per cent of that height, or 24.75 feet. A. At an altitude of 3,000 feet the pressure of the air is about 27 inches when it is 30 inches at the sea level. This is a tenth less than normal; hence a pump will lift water nine-tenths as high as when the barometer is at 30 inches. The height to which an ordinary pump will lift water is practically 33 feet to 30 feet at full pressure; hence at 27 inches such a pump will lift 25 feet to 27 feet. This of course is on the supposition that the pump is in good condition.

(9725) S. L. S. asks: Please state whether the current from a step-down transformer is direct or alternating? A. All stationary transformers deliver alternating currents. The step-down transformer receives an alternating current of a certain voltage and changes it to a lower voltage. A step-up transformer delivers the current at a higher voltage than it receives it. Neither of them can transform a direct current. This can only be done by a rotary transformer. 2. How is a wireless signaling receiver made? A. The coherer is the principal instrument for receiving the signals by a wireless telegraph. Its construction is given in our SCIENTIFIC AMERICAN of September 14, 1901, price ten cents. Full details for the whole apparatus are to be found in this paper.

(9726) L. W. asks: In reference to the construction of condensers to be used in connection with induction coils, will you please advise, under Notes and Queries, whether it is absolutely necessary that the foil must be pure tin foil, or whether the ordinary foil used for various purposes, which I understand is a combination of lead and tin, will answer the same purpose equally as well? A. A condenser may be made of any kind of metal. Tin foil is ordinarily used, since it can be rolled into very thin sheets, which also have considerable strength and stiffness. It is light as compared with the heavy and thick sheets of the so-called tin foil, which contains lead. Only the surface of the plates of the condenser have any part in its action. Hence the lighter the sheet, the better adapted it is for the purpose.

(9727) H. L. B. writes: While experimenting with a small induction coil, I discovered the following, which may be useful to some, i. e., on the interrupter, not having platinum points, if a drop of water be placed on the point of contact with the vibrator, the interrupter will work perfectly, just as if it had platinum contact points. A. Water acts to keep the contact points cool. A break under water would be better, and under oil better still. Alcohol makes a very sudden break, and is used in some interrupters to cover the contact of the vibrator.

(9728) J. L. P. asks: What is the difference in one square foot and one foot square? A. In one sense there is no difference between a square foot and a foot square, that is, 1 square foot and 1 foot square. Both mean a figure with four right angles and four equal sides, containing 144 square inches. In another and better sense there is a difference between the terms. A foot square is a square figure one foot on a side; but a square foot is any area which contains 144 square inches. If one buys a square foot of board, he may wish a piece 1 inch wide and 12 feet long, or a piece 6 inches wide and 2 feet long, or any other shape which will give him 144 square inches in area. You may have a square foot in the form of a circle or an irregular figure of any conceivable shape. In the last sense, a square foot is not the same thing as a foot square. If you had carefully defined the words you were using, you need not have bet about it. But we cannot decide the bet unless we decide that the two expressions are *not the same.*

(9729) F. M. asks: Please tell me how many pounds each of magnet wire are required for the armature and field magnet for the simple electric motor described in SUPPLEMENT No. 641. Will the simple electric motor work if made twice the original size? A. The amount of wire required for the simple electric motor of SCIENTIFIC AMERICAN SUPPLEMENT No. 641 is about as follows: For armature core, 200 feet No. 18 B. & S. iron wire, about 1¼ pounds; for field, 400 feet No. 16 B. & S. wire, 3¼ pounds; for armature, 350 feet No. 18 B. & S. wire, 2½ pounds. As some will wind the wire more closely than others these amounts are only close approximations, and it would be better to allow a slight excess. It is not advisable to build the motor larger, since it is not adapted to heavy work. It is designed for an amateur to build who has little experience with tools. Its wooden parts will not stand strain. It is an excellent machine for its purpose.

In our reply to Query 9681, issue of July 15, by a typographical error 32 thousand millions, English, was made equivalent to 32 millions, or 32,000,000 French. Of course, any one who knows will see that the word *millions* should be *milliards*, the French word for a thousand million.

NEW BOOKS, ETC.

THE STUDY OF CHEMICAL COMPOSITION. By Ida Freund. Cambridge: University Press, 1904. 8vo.; pp. 650. Price, $5.50 net.

This work, which is one of the books in the Cambridge Physical Series, gives an elaborate account of the method of chemical composition and the historical development in the study of the same. In the earlier part of the work the author has sought to demonstrate that the notation by which chemical composition is usually represented can be developed from a purely empirical basis, independent of any hypothesis concerning the ultimate constitution of matter; while in the subsequent treatment of the subject of composition on the basis of the atomic and molecular theory, she has endeavored to keep distinct the boundary line between facts and hypotheses, and to emphasize those special features of the argument which bring out the nature and function of hypotheses, and their place and importance in the science of chemical composition. The author has dealt in detail with a few researches which she could utilize repeatedly from various points of view, rather than tracing separately the entire historical development of the subject. She has not only stated final results, but has reproduced the values obtained in the actual measurements made, so as to indicate the scope of the work involved, and the degree of accuracy obtained in each instance. In stating the various great discoveries, Miss Freund has quoted largely from classical memoirs, and has given as much as possible the actual language used by the experimenters in announcing their own discoveries. The book has also a considerable number of explanatory interpolations and footnotes which will greatly aid those having no previous knowledge of chemistry in following its argument. The chapter on crystallography, which has been introduced into the work, will be found valuable to the average student, because not enough information on this subject is available in current textbooks to allow one to appreciate the results obtained in the study of the relation between crystalline form and chemical composition. All the great discoveries in the science of chemistry will be found set forth in considerable detail within the pages of this work.

THE NEW KNOWLEDGE. By Robert Kennedy Duncan, Professor of Chemistry in Washington and Jefferson College. New York: A. S. Barnes & Co., 1905. 8vo.; pp. 263. Price, $2.

This volume of the New Science Series gives in a popular manner the information to date upon many of the problems in physics and chemistry which are of interest to-day, and which have not been altogether solved. Such conceptions as the three entities; compounds and elements; the periodic law; gaseous ions; the resolution of the atom; and inorganic evolution are described in full. A considerable portion of the work is given up to radio-activity, which is discussed in all its forms. The last part of the work deals with the new knowledge and old problems, and explains, from the modern point of view, such things as the age of the earth, the zodiacal light, aurora borealis, and atmospheric electricity. The reconstruction of the universe is also discussed, and the definitions of science redefined. The book will, no doubt, serve its purpose as a popular science volume, and will be found of real value.

OUTLINES OF INORGANIC CHEMISTRY. By Frank Austin Gooch and Claude Frederick Walker. New York: The Macmillan Company, 1905. 8vo.; pp. 514. Price, $1.75.

In this textbook of chemistry it has been the aim of the authors to introduce the student to the study of the science by the consideration of the simplest and fewest things. The experimental phenomena have been so placed that the inferences drawn from them can hardly be missed. The book is in two parts, of which the first treats of the consecutive experimental development of the principles upon which systematic chemistry rests. With such inductive reasoning the consideration of the identity of substances, chemical change, the chemical elements, and the laws of combination and chemical equivalents naturally come first. In treating of equivalents—electrical, chemical, and thermal—electrical phenomena and ions, and the constitution of acids, bases, and salts from the ionic point of view; conditions of action and equilibrium; and the thermal relation of chemical action, are all discussed in succession. From this discussion the idea of valence is developed, as is also the conception of the molecule.

In the second part of the work the discussion of the properties of elements and their compounds is gone into. With some modifications, Mendeléff's periodic system is followed, as it enables orderly treatment. Graphic symbols are employed, and the ionic terminology has been made use of, the function of ions as parts of compounds and units of reaction being pointed out. The book is one of the latest and best elementary textbooks of chemistry which has so far been published.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending July 25, 1905

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Abdominal supporter and truss, H. F. Lacy, 795,024, 795,[illegible]
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Stacking derrick, hay, A. T. Boney	795,576
Stair rod and eye, B. Draper	795,590
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Wrench, F. G. Cornell	795,428
Wrench, A. Gagnon	795,434
Wrench, F. W. Stanton	795,456
Wrench, O. W. Blake	795,682
Yarn from short fiber material, manufacturing, R. Krun	795,776

DESIGNS.

Bracelet, F. Mason	37,498
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Piano case, W. Lane	37,500, 37,501

LABELS.

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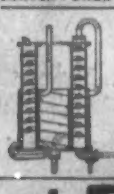

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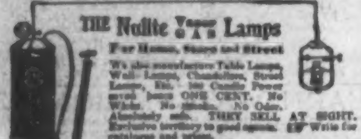

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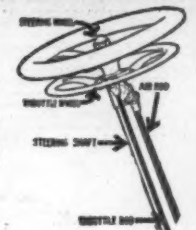

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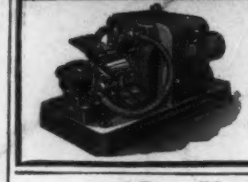

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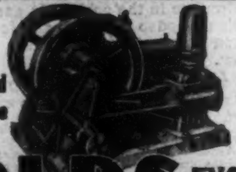

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